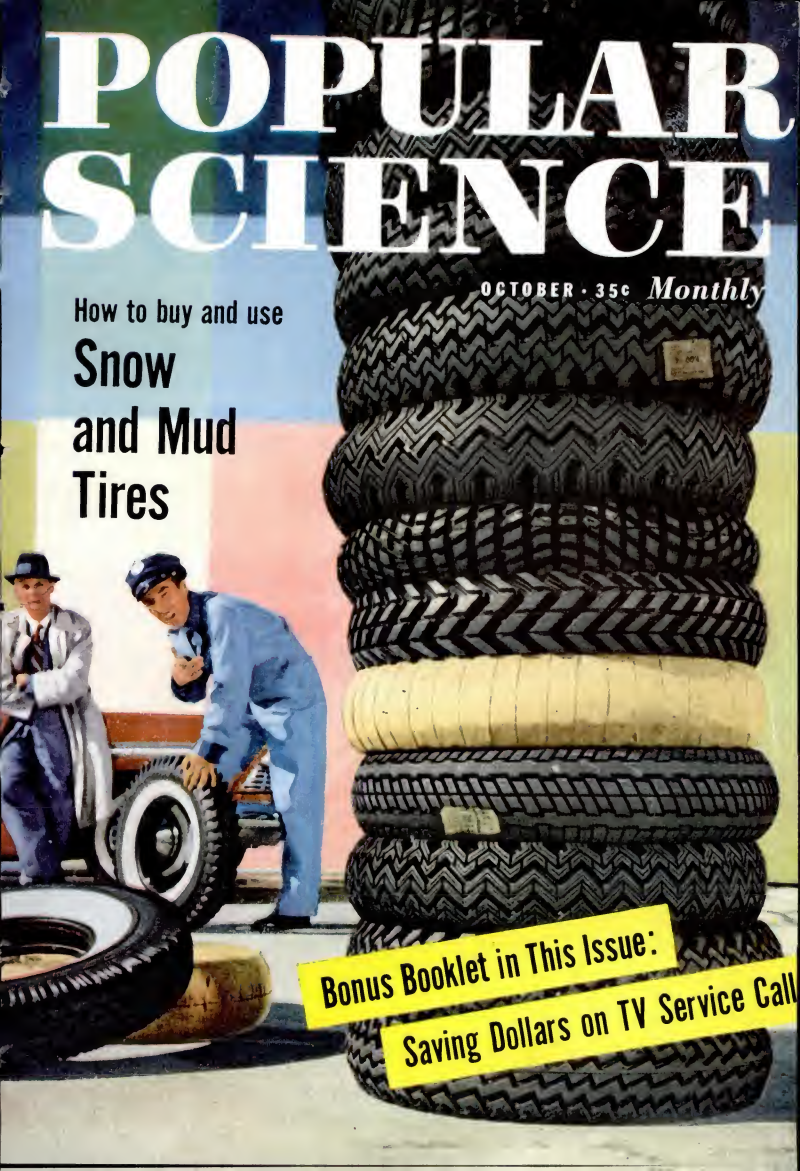
POPULAR SCIENCE

OCTOBER · 35¢ Monthly

How to buy and use

Snow and Mud Tires



Bonus Booklet in This Issue:

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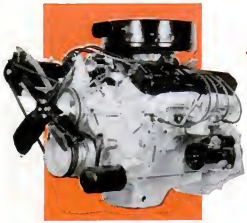
Popular Science Monthly

October, 1957

Cover photograph by O. W. Link



Light but brawny, new engine is coming in '58 for Chrysler, De Soto, Dodge

From sheet metal and tubes, skilled craftsmen form the horns that make the music go 'round and 'round for 2,000,000 breathless Americans

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Peace at last in the TV home! PS shows you how to make these simple wireless headsets that let you tune in or enjoy silence

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PS Readers

TALK BACK

Federal Excise Tax Plus

REFERRING to "What Makes Cars Cost So Much?" [August]: To me, the point that seems to call for the utmost emphasis is the fact that the aggregate of direct, indirect and overall cumulative taxes, in-

stead of being only $200 on a $2,000 factory car, is possibly nearer $1,000.

A car costing $2,000 at the factory probably sells out here for a minimum of $2,800 to the buyer. This buyer, if he earns $85 weekly, is regularly milked of 30 per cent of that for taxes, so that in order to buy a $2,800 car, he must first have earned $4,000.

JOHN W. MORTON, San Rafael, Calif.

A Pilot Had the Last Word

I WONDER if Eliot Tozer [History's Most Fateful Weather Forecast, June] left it out, or didn't know: On D-Day, before Ike gave a nod to *anyone*, he waited for the report of Francis J. Dillon, tactical reconnaissance pilot, who flew his P-51 so low over the beaches studying and photographing the surf, waves and defenses of those beaches that he almost got his feet wet. Reports of the meteorologists were fine, but nothing beats a first-hand look-see. Frank was given the DFC for his weather-snooping mission.

GEORGE D. JAMES JR., Unadilla, N. Y.

More to It Than Science

WE WIVES of PS subscribers enjoy reading your magazine as much as the men in our families do. I was especially interested in "You Ought to Know" [July]. Many scientists and great men may believe that, as the paragraph on radioactive genesis stated: "*Something* made the elements join into simple and finally complex elements." But the truth of the matter is stated in Genesis 1:1: "In the beginning *God* created the heaven and the earth" and again in Psalms 33:6: "By the word of the Lord were the heavens made."

MRS. KENNETH WILLIS, Walworth, Wis.

Booklet Saves $'s, Sweat, Tears

MANY thanks for your booklet "What to Do When Your Car Conks Out" [July]. Two days after I had slipped your magic little booklet into the car, I put it to use. It not only saved me some dollars in towing and repair, but most of all, on that day it saved me many hours of waiting and aggravation.

JACK SOBOL, Westbury, N. Y.

Why Wash Records?

YOUR August article on how to take care of hi-fi records was great. I have lots of long-playing records in my collection which I prize highly. But I'm curious—

why put a record in soap and water when you can buy a record cloth to clean it?

JOHN ELLIS, Huntsville, Texas

Wiping with a cloth will not remove imbedded dirt. And repeated wiping with a cloth builds up a film that should eventually be removed by washing.

Seeks Balance in Career Scale

AS MEMBERS of the largest industry in the world, we feel that "How to Help Your Youngster Choose a Career" [July] may leave a misleading impression regarding opportunities in the food field.

In the chart on pages 78-79, only one of the retail-store positions in the food industry is included: grocery clerk. We consider the position of grocery clerk as

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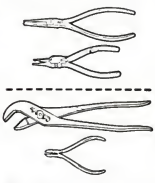

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ROBERT E. MONROE and WM. J. MULLEN, Kroger Co., Cincinnati

Way of Checking Not Adjusting

IN "How to Take Care of a '57 Chevy" [July], your suggested procedure for *adjustment* of the choke setting on the Rochester four-barrel carburetor is in error. Actually your procedure is only a method of checking the coil index mark on the choke cover. Adjustments, if necessary, should be made to factory specifications.

J. P. NALLY, Adv. & Service Sales Mgr. Rochester Products Div., General Motors

You're right. The procedure described on page 150 is really a check on the choke-valve's position at various room temperatures. Once properly set, the bimetallic coil automatically compensates for temperature variations.

Hypnosis Not All Parlor Tricks

JOHN K. LAGEMANN'S article [July] on hypnosis does the cause of hypnotherapy and experimental hypnosis much harm by calling so much attention to a few spectacular cases mishandled by

amateurs. True, parlor tricks can be dangerous. But anything can be misused, even alcohol and automobiles.

It would be a step backward to legislate

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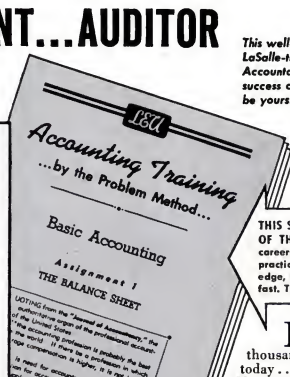

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against hypnosis because the very profession [physicians] that he suggests should monopolize it fought it for a century. Hypnotism was kept alive only by the amateurs and a very few doctors. This same profession fought the field of psychology and psychosomatic medicine for years.

If we keep open minds, we may come to realize that providence has given us a safe anesthesia for pain without dangerous drugs, a method to gain great insight into the subconscious and superconscious, a new efficient method of learning and a help for our neurotic tranquilizing-pill society.

ROGER PIERCY, Phoenix, Ariz.

PS Plans Put King on a Throne

MY SON is now king of the neighborhood, thanks to this midget racing car I constructed from plans in April, 1955, PS. The car has an aluminum body, rack-and-pinion steering, locomotive-type brakes, two-hp. Continental engine and airplane tail wheels. It took me four months to complete and I wouldn't take three times the $200 it cost.

Bypassing the governor, yours truly sat astride it last week and was clocked at 38 m.p.h. and still gaining speed.

HAROLD J. KERN, Perrysburg, Ohio

Hot Wire Is Switched

IN THE first illustration on "How to Install Outdoor Wiring" [July] you show the white or grounded wire going through the switch. The black or "hot" wire should be broken by the switch and the white spliced through to the light.

JAMES J. NELSON, Long Island City, N. Y.

. . . page 124 shows a junction box with a switch above—the white wire being switched. Grounds are never switched.

CRAIG HENELMAN, Lake Hiawatha, N. J.

. . . Just a word to let you know that you goofed . . .

DELMAR WESTON, Quapaw, Okla.

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For fun, sports, protection against prowlers. Precision-made in highest traditions of German guncraft. Exact model of death-dealing automatic. Uses only .22 cal. harmless blanks. WHAM! What a noise! Enough to frighten daylights out of any character hundreds of feet away. 6 shot fully AUTOMATIC Safety catch. Self-ejecting clip. Carbon steel construction. No permit needed. Shipped anywhere (except to N. Y. State residents). Why pay up to $12.95 for this beauty—buy DIRECT and SAVE needless distribution costs. Our price: $6.69 all import taxes paid. Positively our LOWEST PRICE EVER! Prompt delivery. 10-day home trial. Money back guarantee.
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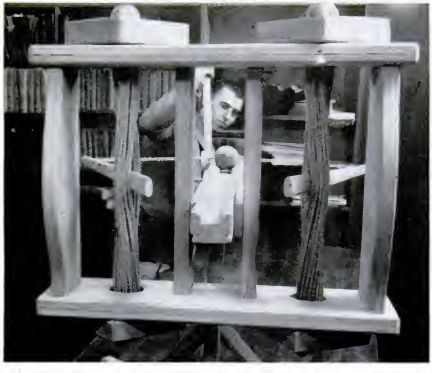
☐ Check here if you also wish to order Zephir Thin Watch advertised on back cover for $7.98 plus 80c Federal tax. Total: $8.78.

Canadians: Address 439 King St., W., Toronto 2B

Prize Projects BY PS READERS

Galleon from PS Plans. Since 1927 Stephen R. Stana of Greensburg, Pa., has been binding POPULAR SCIENCE model plans in a book for later reference. Using these plans, his 15-year-old son Regis spent eight months of spare time building this spanking model of the good ship Revenge. The plans appeared in April-August PS, 1933.

Home-Designed Buffet. Except for two carvings on the doors, which were copied from an Aztec pyramid near Mexico City, this entire buffet was designed by Rudy Schurmann of Franklin Square, N. Y. Schurmann used pine for the buffet, stained it with a honey-colored water stain, then finished it with wax. The grille for the glass doors of the buffet was made from 1/4" brass rod.



Ancient Secret Weapon. This exact replica of a catapult used as a standard artillery piece in 200 B. C. was built by Richard G. Plummer of Milwaukee, Wis., for his history-of-science course at Cornell University. Plummer worked from scale drawings prepared by German scholars. The Greek invention is cocked by twisting the multiple strands of rope on each side of the frame with wooden arms inserted in them. A trigger is released, the ropes unwind, the arms snap home and the missile is flung out the trough.

Have *you* recently completed a workshop project of which you are particularly proud? Send a good photograph of your work, along with the negative and a brief description, to the Mechanics and Handicraft Editor, POPULAR SCIENCE, 353 Fourth Ave., New York 10, N. Y. We will pay $15 for each item that is accepted for publication.

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Right now, a solid, proven field of opportunity for good pay is servicing the millions of Television and Radio sets now in use. With NRI's Servicing Course, *without extra charge*, you get NRI kits developed especially to give actual practice with Television-Radio equipment. You build, test, experiment with actual Television-Radio receiver circuits; build, use testing equipment. All equipment is yours to keep.

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Technical Know-How Brings Better Pay, Advancement

NRI TRAINED THESE MEN

"My income has steadily increased in Radio. I have advanced to Chief Engineer of TV Station KTIV."—A. H. SMITH, Sioux City, Iowa

"Fix sets part time in my shop. Made about $500 first three months of the year. Could have more but this is about all I can handle."—FRANK BOREE, Lorain, O.

"I've come a long way in Radio and Television since graduating. Have my own business on Main Street."—JOE TRAVERS, Asbury Park, New Jersey.

"Before finishing the NRI course I was employed as Studio Engineer at KMMJ. I am now announcing."—BILL DELZELL, Grand Island, Nebraska.

New electronic products are boosting the need for more and more trained TV-Radio Technicians. Offices, plants, homes everywhere—are obliged to buy their knowledge and services. For instance, transistor Radios, Color TV, Hi-Fi, were unknown a few years ago. Guided missiles, computing machines, automation would not be possible without this miracle science—Electronics. Police, Aviation, Mobile Two-Way Radio are expanding. The military services reward qualified Technicians with higher rank and pay. To ambitious men everywhere, here is rich promise of fascinating jobs, satisfaction and prestige, increasing personal prosperity.

Start Soon to Make $10, $15 a Week Extra Fixing Sets

NRI students find it easy and profitable to start fixing sets for neighbors and friends a few months after enrolling. Use the Tester built with parts NRI furnishes to locate and correct TV-Radio receiver troubles. Picking up $10, $15 and more a week gives substantial extra spending money. Many who start in spare time, soon build full time TV-Radio businesses.

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You don't have to know anything about electricity or Radio to understand and succeed with NRI courses. And you train in your own home—keep your present job while learning. NRI has developed simplified, practical training methods. Ambitious men can get ahead fast. Many successful NRI men did not finish high school. Mailing the coupon can be one of the most important acts of your life. Do it now. Reasonable tuition, on low monthly payments. Let us send you an actual lesson FREE. Judge for yourself how easy it is to learn. A 64-page catalog gives details of opportunities and training. Address: **NATIONAL RADIO INSTITUTE, Dept. 7KB, Washington 16, D.C.**

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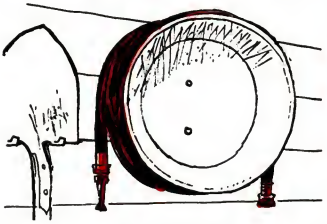
ALL-YEAR WINDOW SASH is easy to install in a basement or other small window. Top-hinge the inside sash and the screen so they swing inward, and the storm sash so it opens outward.



REEL UP THE GARDEN HOSE for the winter on an old dishpan mounted on a garage or basement wall. For a firm support for the hose, drive two broad-head nails through the pan into a stud.

PLAY-YARD EQUIPMENT takes a beating over the winter. Refinish all painted parts of seesaws, sandboxes and swings, and protect unfinished wood by coating liberally with raw linseed oil.

TO WINTERIZE A ROOM AIR CONDITIONER, wrap it neatly in a piece of plastic cut from a tablecloth or shower curtain. Seal the edges of the wrapping with waterproof friction tape.

GREASY STOVE BURNERS soaked overnight in a solution of ammonia, detergent and water can be cleaned up fast. After the bath, a few swipes with steel wool make them look new again.

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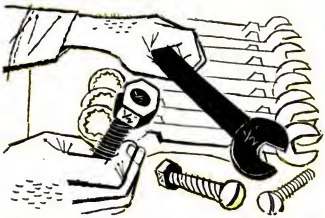
"I'd like to see them make..."

AN INFLATABLE DOG HARNESS for duck hunting. Equipped with a pair of pontoons, a retriever would expend less energy in the water keeping afloat.—*Neil Daugherty, Erie, Pa.*

A RAINCOAT POUCH shaped to serve as a waterproof hat or a protector for a hat. You could wear it after the folded plastic coat is taken out. —*Harold McKay, San Francisco.*

A BUMPER JACK operated by carbon-dioxide gas. Set it in place, press a lever and the jack would rise slowly and stay in position until the gas was released.—*Leon Hooper, Chicago.*



EASY-TO-IDENTIFY HEXAGON BOLTS, each stamped for its own wrench size. With these, you could pick up the right box or open-end wrench the first time.—*Bob Ramsey, Parker, Pa.*

DOOR LEVERS, shaped to fit the forearm, that would open entrance doors when pressed down. Turning a knob is awkward if you have packages in your arms.—*Charles E. Tuma, Chicago.*

Everyone has his own pet idea of a gadget that he would like to see in general use. The five ideas illustrated above were suggested by POPULAR SCIENCE readers. What's *yours?* We will pay $5 for each one published. Please use Government postcards only. Write name and address clearly. Contributions cannot be acknowledged or returned.

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NOW—for a limited time only—we are giving away FREE our famous $4.98 Powerhouse "77" Binoculars with every trial order for our new 1958 Powerhouse German Telescope! Keep the binoculars FREE even if you return Telescope for full and prompt refund! But you must act fast. This sensational FREE GIFT offer will be withdrawn as soon as our stock of binoculars is depleted—and they are going fast! Rush coupon below today. SEND NO MONEY unless you wish to!

5 SYNCHRONIZED LENSES!

Most low cost telescopes use 2 lenses—but this new 1958 Powerhouse uses 5—yes FIVE genuine synchronized Rethler lenses—all ground and polished with meticular precision. They are not glued, but ANCHORED in sturdy STEEL RINGS! The draw tubes are heavy duty METAL! Here is a quality optical instrument—the crowning achievement of the renowned 102-year-old Rothler plant in West Germany—famed for their precision cameras, telescopes, binoculars, etc.

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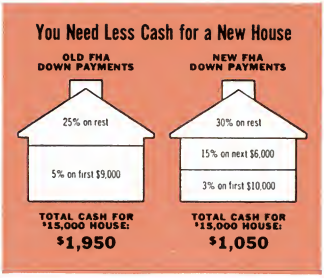
You ought to know...

It's easier to buy a new house now—but it will cost you more in the end. The easier part is the down payment. FHA has reduced its cash requirements (chart below) so that you can get a $15,000 house for what you would pay down on a new car. The harder part is the interest, because FHA raised rates to 5¼ percent. This means your monthly payments on that $15,000 castle (minimum down payment and 25-year mortgage) will be higher ($83.70, up $7.36), while your total outlay for interest over 25 years jumps $1,300.



If you are entitled to a GI loan, look into that kind carefully—your chance to get one runs out next June 30. GI mortgages carry both lower interest rates and lower down payments than FHA mortgages. But money is so tight now that few banks will talk business on them. And those banks that do are charging such stiff discounts (interest concealed as an addition to the base price of the house) that the advantage of a GI loan may be largely theoretical.

The tragic death last summer of a six-year-old boy, electrocuted by the family TV set, may force correction of an electrical-appliance hazard that PS has repeatedly warned you about. Statistically, the danger is not great (Metropolitan Life Insurance figures show about 200 deaths per year from all kinds of home electrical accidents). But this hazard is one that could be avoided fairly easily.

The trouble arises because a great many TV sets have metal cabinets enclosing hot chassis—the metal sheet supporting the works carries current (this is the transformerless, series-wired circuit, now practically standard). The cabinets are supposed to be insulated from the chassis. But it's easy for a screw to be driven too far, or a metal part or snip of solder to fall between chassis and cabinet. Then the cabinet, too, can become directly connected to the hot side of your 110-volt line.

You can, however, make such a set safe. Your house has two wires carrying current; one is at 110 volts potential while the other is neutral (ground, or zero, potential). If you put the plug in so that the neutral house wire goes to the chassis, the chassis is at ground potential and shock-free. How can you tell? Use a neon tester (less than a dollar at an electrical store). If the neon does not light when you put one tester lead on the chassis and the

You ought to know...

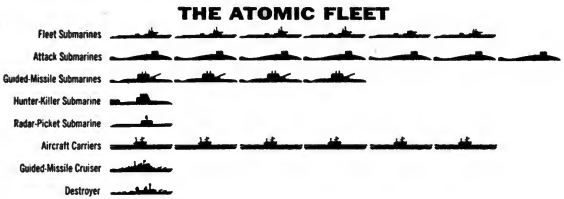
other on a ground (the screw in the outlet cover), you're okay. If it does, reverse the plug and test again.

Still better would be a polarized three-prong plug like the ones now standard on power tools and major appliances. You could plug it in only the right, safe way. And the third prong would make a separate connection between a metal cabinet and ground, blowing the fuse if the cabinet accidentally became charged. It requires a special outlet or an adapter for present outlets.

The president of one of the largest TV firms told POPULAR SCIENCE that his company would be delighted to put polarized plugs on its sets—but it did not dare to be first with receivers that couldn't be plugged into any old wall outlet.

The Navy goes nuclear. Today there are only two atomic ships in the world. But by 1966 close to half the entire U.S. fleet will be under way on nuclear power. A vast building program costing billions of dollars, reports the trade journal *Nucleonics*, will generate 30 warships and perhaps 100 nuclear reactors (chart below).

Two reasons for this rapid and historic switchover: (1) unlimited range—the A-sub Nautilus steamed 70,000 miles in 26 months before it had to be refueled, and (2) sustained speed.

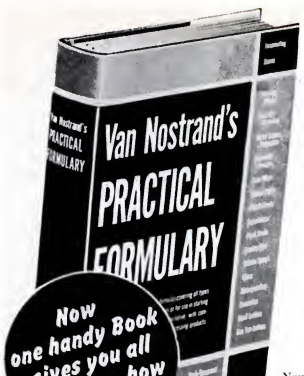


A-ships, unlimited by fuel, can run flat out 90 percent of the time.

The Navy's main effort is going into submarines (19 now planned), particularly the whale-like attack types that are "flown" underwater at a reported 60 m.p.h. with airplane-style controls, and carriers (the first will use eight separate atomic engines).

Atomic power would pay off most in destroyers, the real workhorses of the Navy. Today's tin cans are severely handicapped by fuel hunger—they have to refuel at sea every five to 10 days.

A rocket could reach the moon this month. That's the speculation among scientists working on Project Farside (see p. 134), which will send a three-stage rocket to 4,000 miles and 17,000 m.p.h. At that altitude and speed, "escape" from the earth's gravitational attraction is conceivable—with no theoretical reason why some of the hardware won't keep going and run into the moon.



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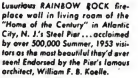

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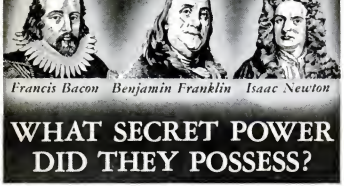

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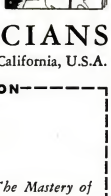

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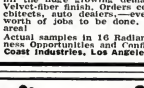

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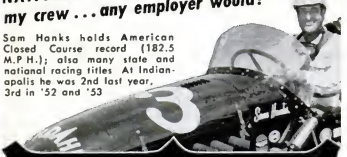

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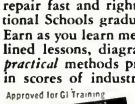

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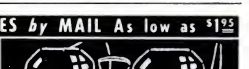

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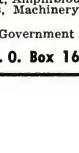

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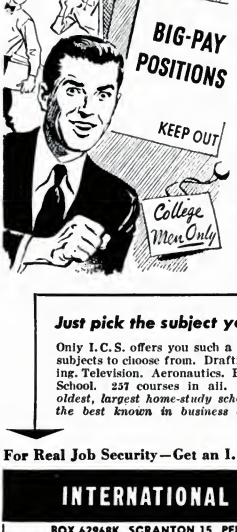

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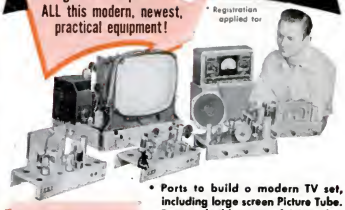

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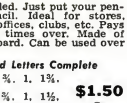

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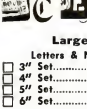

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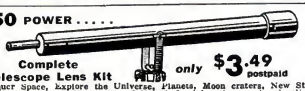

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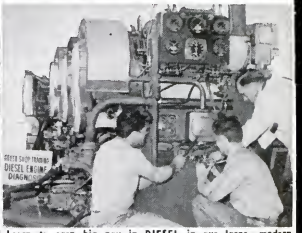

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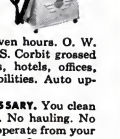

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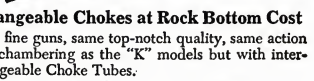

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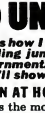

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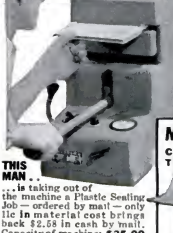

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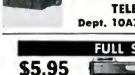

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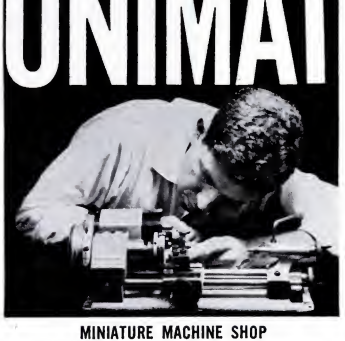

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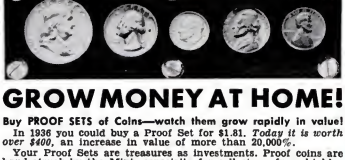

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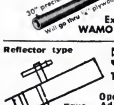

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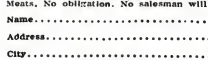

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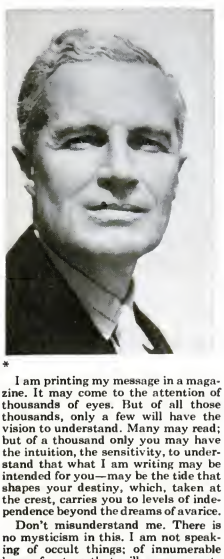

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I'd like to give this to my fellow men...

while I am still able to help!

I was young once, as you may be—today I am older. Not too old to enjoy the fruits of my work, but older in the sense of being wiser. And once I was poor, desperately poor. Today almost any man can stretch his income to make ends meet. Today, there are few who hunger for bread and shelter. But in my youth I knew the pinch of poverty; the emptiness of hunger; the cold stare of the creditor who would not take excuses for money. Today, all that is past. And behind my city house, my summer home, my Cadillacs, my Winter-long vacations and my sense of independence—behind all the wealth of cash and deep inner satisfaction that I enjoy—there is one simple secret. It is this secret that I would like to impart to you. If you are satisfied with a humdrum life of service to another master, turn this page now—read no more. If you are interested in a fuller life, free from bosses, free from worries, free from fears, read further. This message may be meant for you.

By Victor B. Mason

I am printing my message in a magazine. It may come to the attention of thousands of eyes. But of all those thousands, only a few will have the vision to understand. Many may read; but of a thousand only you may have the intuition, the sensitivity, to understand that what I am writing may be intended for you—may be the tide that shapes your destiny, which, taken at the crest, carries you to levels of independence beyond the dreams of avarice.

Don't misunderstand me. There is no mysticism in this. I am not speaking of occult things; of innumerable laws of nature that will sweep you to success without effort on your part. That sort of talk is *rubbish!* And anyone who tries to tell you that you can *think* your way to riches without effort is a false friend. I am too much of a realist for that. And I hope you are.

I hope you are the kind of man—if you have read this far—who knows that anything worthwhile has to be *earned!* I hope you have learned that there is no reward without effort. If you have learned this, then you may be ready to take the next step in the development of your karma—you may be ready to learn and use the secret I have to impart.

I Have All The Money I Need

In my own life I have gone beyond the need of money. I have it. I have gone beyond the need of gain. I have two businesses that pay me an income well above any amount I have need for. And, in addition, I have the satisfaction—the deep satisfaction—of knowing that I have put more than three hundred other men in businesses of their own. Since I have no need for money, the greatest satisfaction I get from life, is sharing my secret of personal independence with others—seeing them achieve the same heights of happiness that have come into my own life.

Please don't misunderstand this statement. I am not a philanthropist. I believe that charity is something that no proud man will accept. I have never seen a man who was worth his salt who would accept something for nothing. I have never met a highly successful man whom the world respected who did not sacrifice something to gain his position. And, unless you are willing to make at least half the effort, I'm not interested in giving you a "leg up" to the achievement of your goal. Frankly, I'm going to charge you something for the secret I give you. Not a lot—but enough to make me believe that you are a little above the fellows who merely "wish" for success and are not willing to sacrifice something to get it.

A Fascinating and Peculiar Business

I have a business that is peculiar—one of my businesses. The unusual thing about it is that it is needed in every little community throughout this country. But it is a business that will never be invaded by the "big fellows". It has to be handled on a local basis. No giant octopus can ever gobble up the whole thing. No big combine is ever going to destroy it. It is essentially a "one man" business that can be operated without outside help. It is a business that is good summer and winter. It is a business that is growing each year. And, it is a business that can be started on an investment so small that it is within the reach of anyone who has a television set. But it has nothing to do with television.

This business has another peculiarity. It can be started at home in spare time. No risk to present job. No risk to present income. And no need to let anyone else know you are "on your own". It can be run as a spare time business for extra money. Or, as it grows to the point where it is paying more than your present salary, it can be expanded into a full time business—overnight. It can give you a sense of personal independence that will free you forever from the fear of lay-off, loss of job, depressions, or economic reverses.

Are You Mechanically Inclined?

While the operation of this business is partly automatic, it won't run itself. If you are to use it as a stepping stone to independence, you must be able to work with your hands, use such tools as hammer and screw driver, and enjoy getting into a pair of blue jeans and rolling up your sleeves. But two hours a day of manual work will keep your "factory" running 24 hours turning out a product that has a steady and ready sale in every community. A half dollar spent for raw materials can bring you six dollars in cash—six times a day.

In this message I'm not going to try to tell you the entire story. There is not enough space on this page. And, I am not going to ask you to spend a penny now to learn the secret. I'll send you all the information, free. If you are interested in becoming independent, in becoming your own boss, in knowing the sweet fruits of success as I know them, send me your name. That's all. Just your name. I won't ask you for a penny. I'll send you all the information about one of the most fascinating businesses you can imagine. With these facts, you will make your own investigation. You will check up on conditions in your neighborhood. You will weigh and analyze the whole proposition. Then, and then only, if you decide to take the next step, I'll allow you to invest $15.00. And even then, if you decide that your fifteen dollars has been badly invested I'll return it to you. Don't hesitate to send your name. I have no salesmen. I will merely write you a long letter and send you complete facts about the business I have found to be so successful. After that, you make the decisions.

Does Happiness Hang on Your Decision?

Don't put this off. It may be a coincidence that you are reading these words right now. Or, it may be a matter that is more deeply connected with your destiny than either of us can say. There is only one thing certain: If you have read this far you are interested in the kind of independence I enjoy. And if that is true, then you must take the next step. No coupon on this advertisement. If you don't think enough of your future happiness and prosperity to write your name on a postcard and mail it to me, forget the whole thing. But if you think there is a destiny that shapes men's lives, send your name now. What I send you may convince you of the truth of this proverb. And what I send you will not cost a penny, now or at any other time.

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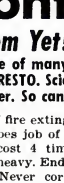

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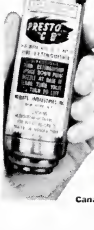

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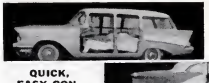

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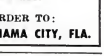

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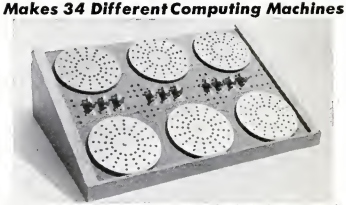

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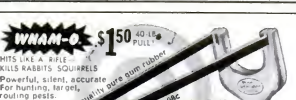

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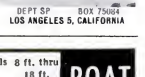

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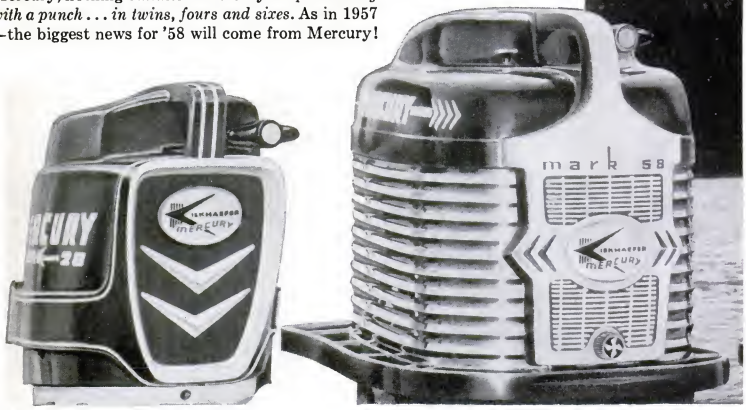

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Before paying out good money for two extra tires, you'll probably want to know exactly what they can do for you. Will they deliver the extra traction needed on snow, in mud, on ice? Do they eliminate the need for chains? Will they wear out faster than regular tires? How should you pick them?

For the answers, Popular Science went to tire manufacturers, queried rural mail carriers, studied National Safety Council tests. Here's what we learned about buying and using—

Snow and Mud Tires

By Harry Walton

SPECIAL tires designed to deliver better traction for slick going will be even more popular this year than last, when a survey showed 23 percent of car owners using them. They have been gaining not only in snow country, but in the South and West, where mud is the big problem.

Recaps will be available this year, except perhaps in the 14-inch size. If you sport a late-model car with 14-inch wheels, you'll probably have to buy new mud-and-snow tires. There haven't been enough worn casings in this size for recapping this season, nor are the necessary molds as yet widely distributed, tire makers say.

Snow treads aren't cure-alls for the many skittish problems of winter driving. Nothing beats chains on glare ice or hard-packed snow (chains have about four times the starting traction, three times the braking ability of snow tires on ice).

But in loose snow and slush the special treads show their stuff over regular ones. They can deliver over 50 percent more starting effort. That can make the difference between driving off and spinning your wheels in motorized frustration, between getting up a hill or not.

In stopping ability, snow treads show up less well. Rolling at 20 m.p.h. in loose snow, you can stop in 60 feet with regular tires, in 52 feet with snowies. But there are times when that eight-foot difference can be a lifesaver.

Chains do better on all counts. According to tests made by the National Safety Council, they'll make that stop from 20 m.p.h. in snow in only 38 feet. On ice, it will take you 77 feet to stop with chains —or a whopping 174 feet with snow tires.

The trouble with chains is that many a driver will try to do without them even if they're in the trunk. They ride hard, wear tires, are a knuckle-busting job to put on and take off, and flog themselves to pieces if run far on dry pavement.

Mud-and-snow tires, on the other hand, are already on when you need them. They'll move you, tire makers say, 90 percent of the time. When they won't, conditions are so bad you should either stay off the road, or do what some state police and rural mail carriers do—put chains on over snow treads.

To buy or not to buy the extra shoes is a question calling for some other answers first. If you are willing and able to put on and take off chains as often as necessary (including the times you go from snowy to clear pavements or vice versa), if you have to drive under all

What rural mail carriers say about snow tires:

To LEARN what big-mileage drivers think of traction treads, POPULAR SCIENCE went to the National Star Route Mail Carriers Association. Here are some comments from the men who get the mails through.

Snow tires are far superior to chains in soft snow and mud and easier on the car, but I have never seen any tire as safe as chains for ice.—GLOBE, ARIZ.

We consider snow tires much more efficient than chains in snow and mud . . . Chains are hard on tires and wear so rapidly their cost is prohibitive.—CASS LAKE, MINN.

It's my opinion that the performance of snow tires is exaggerated.—YORK, PA.

One thing's wrong with mud and snow tires: the better their traction the harder the ride. They go through nearly as much mud and snow as chains, but on ice chains are clearly the boss.—CENTER, N.D.

For nine years snow tires have got me anywhere, in mud and snow. I'd hate to use chains; after three trips on my route, I'd need another set.—YUMA, COLO.

Snow tires help in stopping and starting at mail boxes on hills, but on glare ice don't hold as safely as chains.—EAST WOODSTOCK, CONN.

I mount snow tires November first, take them off about April first.—AUGUSTA, ILL.

Have used snow tires for 18 years and wouldn't be without them.—LA CROSSE, WIS.

Old casings recapped with a snow tread containing sawdust or walnut shells are effective on snow or ice.—ST. MARIES, IDAHO

I've found snow tires a big improvement over regular tires in snow, but on ice they are no better. In tough going they cannot take the place of chains.—ESCANABA, MICH.

Most towns on my route are back from the highway. Without snow tires I don't know how I'd get through.—HURON, S.D.

I go over a pass 7,500 feet high with two to three feet of snow. I make it on snow tires.—PARK CITY, UTAH

sorts of highway conditions, or must keep going at higher speeds than are safe with any tire, chains may be your best bet.

The car owner with an average aversion to hard work, or with other drivers in the family who can't be expected to struggle with chains, should find snow tires worth having. Besides giving him better traction, they'll save some of the mileage in his regular tires.

What makes them grip? The three essentials of almost any snow tread are big, extra-deep tread blocks that dig in for a substantial bite in soft stuff, grooves big enough to clear themselves of embedded snow or mud so as to be effective the next time around, and a transverse block pattern, crosswise to the line of travel.

But a tread made only for traction would be noisy, rough-riding, fast-wearing. The tire you buy is a compromise.

The transverse pattern may be broken up by longitudinal grooves, or modified into a diagonal one for smoother riding and better wear. Noise may be quieted by staggering the tread blocks, by making adjacent ones of different sizes, or by the use of unbroken running ribs, without grooves, in the middle of the tread.

How about noise? The roar and whine of the earlier mud-and-snow tires has been subdued to a point where noise is no longer objectionable. There is of course some difference between treads.

Firestone claims its Town and Country tire is noiseless. Armstrong points out that on noise-meter tests its Silent Storm King has proved quieter than some regular treads. (Tread blocks on this tire and on the Seiberling Commuter vary in length all the way around, breaking down resonance effects.)

Running on ice, the big lugs of snow treads are like so many bald spots. To improve footing on slick surfaces, manufacturers use the following:

Tractionizing. The tread is pierced with thousands of pinholes to a depth of about 3/16″. Invisible singly, they overlap sufficiently to appear as a roughening of the surface. The treatment lasts about a season, and can be renewed.

Kerfs and slits. The blocks in some treads have fine grooves molded in. Others have cross-cuts or slits made after molding. Both methods create edges that have a useful squeegee action on ice. Some tire

ARMSTRONG tread blocks, of varied size and pitch for quiet running, have interlocking kerfs to grip ice.

FIRESTONE has deep edge lugs, long tread bars to cut out noise. Kerfs and tractionizing aid on ice.

GATES uses abrasive particles, a deep tread and shoulder notches, continuous mid-ribs for quiet.

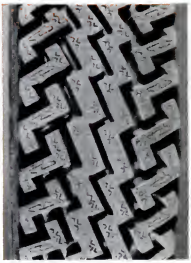
GENERAL goes all out for traction with crosswise grooves and big blocks, staggered at tread edges.

B. F. GOODRICH is a nylon with an anti-blowout liner. Its wide tread has kerfed lugs and is tractionized.

GOODYEAR makes use of enclosed S-shaped and open V kerfs, staggers lugs at edges, tractionizes tread.

LEE molds its treads in a dual V pattern. Deep lugs and wide shoulder notches deliver traction in snow.

SEIBERLING has deep cross-braced lugs varying in length, a wide center groove to cut side slip.



U.S. ROYAL uses continuous running ribs, deep lugs with zigzag kerfs, tractionized tread rubber.

designers say that slitting results in faster tread wear, and that at prolonged high speeds slit sections may be torn out. Others, like Armstrong, mold kerfs well within the blocks so that they're self-supporting.

Abrasives. Used chiefly in recaps rather than in new tires, such materials as ground walnut shells or silicon carbide grit may be added to the tread rubber. Cork, sawdust and glass beads are also used but differ in action; they peel out of the rubber, leaving small holes that provide some grip on slick surfaces.

Coiled or zigzag steel wire is embedded in some snow tires for truck use. As the exposed wire wears down, it leaves sharp ends to dig into ice. Because it's noisy, wire isn't used in passenger-car tires. It is also costly and, a Goodyear engineer told me, may wear faster than the rubber around it and so eventually not project enough to help. Goodyear has found no tread additive as effective as tractionizing, this expert added.

What tread life can you expect? Any open tread (one with big blocks and wide grooves) has less rubber on the road than a closed one and so may wear faster. Counteracting this is the fact that some snow treads are wider and flatter than ordinary ones, and that treads are 50 or 60 percent deeper than on regular tires.

At Seiberling and General, I was advised that snow tires should be put on only for the winter season to avoid undue wear. Both Firestone and B. F. Goodrich, on the other hand, said that many rural users keep them on all year. An Armstrong man told me that some of their snow tires have gone 35,000 miles in year-'round use.

That's probably exceptional, but you can hope to get two or three seasons' use if you switch snow and regular tires in season. As with any tread, fast starts and stops, wheel spinning, and high speed will cost you rubber—and money.

Choosing your tread. If you are out for all the extra traction possible, you can pick a deep-lug, big-groove, transverse-tread tire like the General Winter-cleat. If you do much high-speed driving on clear roads through the snow-tire season and want quieter operation, you may well compromise on a more closed tread

Do You Need Speed Tires?

HOTTEST thing on wheels is a new breed of tires made for sustained high speeds. They're the answer to demands from the West and Southwest, where long distances and thin traffic tempt drivers to let out the horses, often under a desert sun.

When a high-powered engine shoves the speedometer past 90, both centrifugal force and heat are trying to rip tires apart. The furious flexing of the carcass builds up heat within the plies, adding to that from the road itself. Soaring temperature and the centrifugal effect tend to tear the tread off.

Speed tires can take it. Made with nylon, which dissipates heat better than rayon, they have carcass cords crossed at an angle that better resists flexing. Carcass and tread are lighter to carry heat off faster. Sealant is left out for the same reason. Recommended pressures are a few pounds higher than normal.

Fastest of all is the Firestone Super Sports 170, a six-ply nylon to be inflated to 55 pounds. At the cost of comfort, this will run all day at high speeds—up to 170 m.p.h., Firestone says. More moderate drivers can run it at lower pressure for a softer ride.

For drivers who don't want to go *that* fast, there are more comfortable speed tires. Firestone's 500, a four-ply nylon, is speed-, heat- and shock-resistant. With four pounds more air than the car maker specifies, it's said to be good for a steady 105 m.p.h.

The B. F. Goodrich Silvertown 125, a six-ply nylon, travels at 125 m.p.h. sustained in maker's tests. Goodyear's Blue Streak, another premium tire, is also good for a steady 125 m.p.h. with 30 pounds of air. This one may be had with an anti-blowout chamber.

Seiberling offers a four-ply safety nylon they'll back at 100 m.p.h. (it does a sustained 125 m.p.h. on the test drum at a temperature of 100 degrees). Such a drum, loaded until it puts a reverse curve on the tread, is a tougher test than the highway.

General's Nygen Dual-90, which has two distinct tread curvatures with a groove between them, is furnished without sealant in the South and West for speed merchants. Speedwise it gets even better, a General engineer told me, when its thick tread is partly worn down and so loses heat faster.

Want to buy speed? Within reason, you already have it. Standard "100-level" first-line tires (the kind on a new car) can be run steadily up to 65 m.p.h., or even 70 if slightly overinflated. In cool weather, you can get by with 90 for a limited time. Nylons have about a 10-m.p.h. edge over rayons.

Instead of buying speed tires, an official at

Did you know . . . ?

- YOU'RE twice as likely to skid on ice at 32 degrees as you are at zero.
- With a manual transmission, panic braking on ice can stall the engine. The wheels may stay locked when brakes are released, and cause a bad skid.
- Spinning your wheels cuts tractive effort right in half.
- Locked wheels have no steering power. If you want to steer out of danger, don't brake hard.
- To stop on ice as readily as you can from 50 m.p.h. on dry pavement, your speed with reinforced chains cannot be more than 25 m.p.h. With snow tires, only 15 m.p.h.

And these ice-and-snow techniques will help you lick winter driving hazards:

- Face up to winter by preparing your car.
- Feel out bad road conditions by trying the brakes while driving slowly with no other cars near. Reduce speed to suit.
- Make sure you see clearly. Check windshield wipers, blades, defroster.
- Pump brakes for quick stops on slippery roads. Jamming them on is almost sure to lock wheels, minimize braking, cause a skid.
- Give yourself room to stop by staying farther behind the car ahead than usual. Remember, your stopping distance may be three to 12 times as great as normal.
- Put extra weight in the trunk—it's helpful, especially with modern front-heavy cars.
- Try backing out of a tough spot. Backward wheel rotation pulls car weight down on the tires; forward effort lifts it.
- Don't run a snow-tire spare on a front wheel for long. Snow tires are little help there except with four-wheel drive. Some open-tread patterns are prone to cupping and will wear rapidly on the steering end.

pattern. A tire dealer in whom you have confidence may help you decide.

Rayon-cord snow-and-mud tires usually list at 10 percent above first-line (original equipment) tires. Nylon-cord snowies run up to 20 percent higher than regular tires. For anything but a heavily loaded station wagon, some tire men say, rayon is quite satisfactory. Rayon's strength and shock resistance have been greatly improved; it's a good tire cord.

Nylon runs cooler, is more shock-resistant, can be recapped as many as

[Continued on page 248]

B. F. Goodrich points out, average drivers paying a premium price may get more practical value from a four-ply nylon like the B. F. Goodrich Lifesaver. This tire offers such bonus features as puncture sealant and an anti-skid tread, and will stand up to a steady 75 or 80 even in warm weather.

You pay for speed, no matter what tires you have. Speed tires cost from 25 to 75 percent more than first-line rayons to begin with. At 100 m.p.h., they'll wear six to 10 times as rapidly as at 50. Some makers estimate them good for only 3,000 to 4,000 miles when run constantly at top speeds.

On turnpike police cars, however, which may do anything from 60 to 120 but rarely run for long at the higher figure, General reports its Blue Streak has turned in mileages of 18,000 to 20,000.

Pressure is important. To run any tires at high speed, the industry recommends, fill them cold with four to six pounds more air than the car maker specifies. Drive moderately until they get a chance to warm up before you push them to top speed. They will stay cooler and build up less pressure boost than if you start out at normal pressure.

One sure way to trouble, the experts warn, is to start off with a heavily loaded car and hit speeds up in the top eighties right away. The carcass flexes excessively and overheats before the air inside has a chance to warm up, expand, and fill the tire properly.

SPEED VERSUS TIRE: At 90 plus, the ordinary tire begins to look like this. Centrifugal force and the natural flattening of the tread where it touches the road cause this strange weaving action, which engineers call a standing wave. Such flexing builds up inside heat in addition to that from hot highways. Separation or "chunking out" of the tread results.

BORON FOR ZIP FUELS comes from borax—mined underground, as in view above, and more recently by open-pit excavation from surface, at world's largest borax deposit in California.

'Zip' Fuels Pack More W-H-O-O-S-H

Burning hotter than petroleum fuels, man-made propellants will light a new fire under our planes and missiles

FANTASTIC high-energy propellants will soon be driving our jet planes and air-breathing missiles. Nicknamed zip fuels, they'll make our defense surer and our power of retaliation more to be feared.

In contrast with conventional aviation fuels from petroleum, the new ones are synthetic chemicals. These man-made propellants pack far more heat energy into a pound of fuel—and into a cubic foot of it, too. Consequently the aircraft using them will be endowed with correspondingly greater range, speed, or payload capacity.

The most spectacular of the synthetic fuels burn with vivid green fire, and spew out a white cloud from the exhaust. They contain boron, a chemical element obtained from borax. In its pure elemental form, it is a shiny black, hard and brittle solid.

So new that their names aren't yet in the dictionaries, these "exotic" fuels are put together from scratch by man. One of them is a liquid called pentaborane. Malodorous but potent, it yields more than half again the energy of standard JP-4 jet fuel, weight for weight. Another with a pungent but more agreeable smell is a white crystalline solid known as decaborane. Both pentaborane and decaborane are chemical compounds of boron and hydrogen, answering to the formulas B_5H_9 $B_{10}H_{14}$ respectively.

Making them has proved more of a trick than these deceptively simple formulas might suggest; pilot-scale production of decaborane, for example, began only last spring, at a Henderson, Nev., plant. Starting in turn from materials like these, however, chemical wizardry already has produced more sophisticated boron fuels, of closely guarded formulas.

Already being shipped to the Air Force is

GREEN FLAME is striking feature of boron-based zip fuels. Tint simulating it is superimposed on photo of Air Force's ground-to-air Bomarc interceptor missile, one of weapons for which these fuels are especially suited. Twin ramjets (plus rocket booster) propel Bomarc.

Will this formula yield a new fuel?

A POSSIBLE HIGH-ENERGY FUEL is handled in a nitrogen-filled chamber, lest contact with air ignite it. New York University experimenter is putting some into a "pressure bomb" to discover how sensitive it may be to exploding upon impact.

a liquid boron-based propellant named HEF, for high-energy fuel. It has a brown color resembling watered-down maple syrup and comes in two forms, HEF-2 and HEF-3, both of secret composition. Its performance is reported so sensational, increasing the range of air-breathing-engine craft by something like 40 percent, that the Air Force wants all it can get. Developed by the Olin Mathieson Chemical Corporation, HEF currently is being made in a $5,500,000 "semi-commercial" plant at Niagara Falls, N. Y. A $36,000,000 plant due for completion within 20 months will bring really big-scale production.

Another boron fuel named HiCal, which sounds like a vitamin and should prove so for jets, has been developed for the Navy. It's expected to deliver 40 percent more energy than the same volume of conventional fuel, with corresponding gains in speed and range. All that has been revealed of its makeup is that it contains boron, hydrogen and carbon. Its maker, the Callery Chemical Company, has just broken ground for a $38,000,000 HiCal plant at Muskogee, Okla. The Navy calls its high-energy fuel program Project Zip; and so the phrase, zip fuels, has come into general usage. Other armed services and Callery's competitors understandably might favor some other term, but have yet to come up with any as concise and apt.

Encouraged by the success of its projects to obtain chemical super-fuels, the Defense Department now is spurring the development of engines and aircraft to make the most of them. It's pushing Boeing and North American for improved designs for a "chemical" bomber, the WS-110A—so called because the craft will be driven by one of the new fuels. There's been speculation that a high-energy propellant might be able to send a bomber across the ocean and back without refueling.

Nature's best liquid fuel, petroleum—even in the refined forms of kerosene or gasoline—is much too heavy and bulky for a two-way transoceanic trip. Nature's best solid "fuel," uranium, promises unlimited range but has still to be harnessed to aircraft in a practical way. Man-made zip fuels provide the needed way to boost range, right now.

Their high energy has important alternative uses. Zip fuels permit reducing a vehicle's fuel-tank space without crimping range. They make it possible to lighten fuel load, and thus increase speed. Because they burn more quickly and in less space than petroleum fuels do, they offer the possibility of shorter and lighter engines.

They raise problems, too. They burn so hotly that designers will have to pro-

A zip fuel is made— in lab, then in plant

vide special combustion chambers, of new alloys or other materials able to withstand extreme heat. And so far, zip fuels appear unsuited as primary fuels for turbojet engines; their solid or liquid combustion products would quickly gum up a turbojet's turbine blades. However, the turbojet's afterburner is essentially a ramjet, with no moving parts. A dirty exhaust doesn't hamper a ramjet a bit. So jet afterburners can use a zip fuel, with the tremendous boost in power that it keeps on tap for all-out performance.

Where does the zip of the new fuels come from? The energy of a fuel, which determines how much thrust it produces when it burns in a jet engine, depends largely on its heat of combustion. This heating value is measured in British thermal units, or b.t.u.'s, per pound of fuel. (One b.t.u. is the amount of heat that will raise the temperature of a pound of water one degree Fahrenheit.) Aviation gasoline contains about 18,500 b.t.u.'s to the pound; kerosene and JP-4 jet fuel, about 18,000. "High energy" designates fuels in the range of 25,000 b.t.u.'s per pound and up.

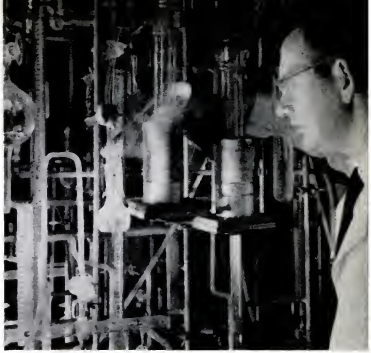
The ideal fuel—if heating value were all that mattered—would be pure hydrogen, which tops the list by a wide margin with 52,000 b.t.u.'s per pound. But to serve as fuel it would have to be kept liquefied, a difficult feat.

Fortunately hydrogen can be locked into liquid or solid form, for use as fuel, by combining it with other elements. Nature does it with carbon, in making the hydrocarbons of petroleum fuels. But for a high-energy fuel, the added element itself must have a high heating value, and carbon's modest 13,000 b.t.u.'s to the pound falls short of requirements.

The logical thing would be to work downward from hydrogen, in the list of heating values of the elements, and chemists have done just that. First they came to the metal beryllium, which yields about 29,000 b.t.u.'s to the pound when it burns. But beryllium was relatively scarce and difficult to refine, and toxic, too. So researchers for the Air Force and Navy projects passed it over.

Next came boron, with 26,000 b.t.u.'s

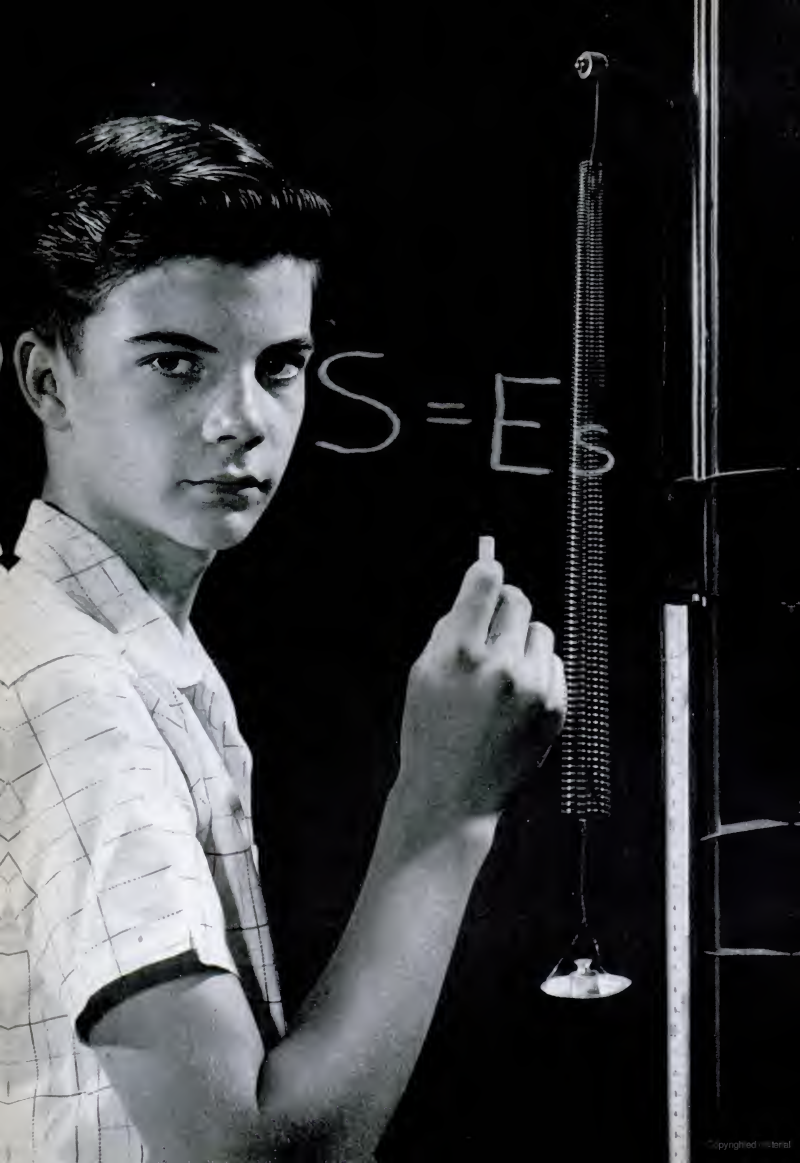
[Continued on page 250]



PRODUCTION OF HEF began in glass apparatus in Olin Mathieson laboratory, where this chemist is brewing a successor to HEF-2 and HEF-3.

NOW THIS PLANT at Niagara Falls ships HEF to Air Force. Sphere holds nitrogen gas, used in secret method for making the high-energy fuel.

CONTROL ROOM, where panels show the status of each operation, is nerve center of HEF plant. A much bigger plant will be built soon.



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How Well Does Your Youngster's School Teach Science?

The future of your child demands solid training in the sciences. Is he getting it? Here's how to tell

By John Kord Lagemann

YOUR youngster has to make his way in a world where science turns the wheels. To help him climb toward success he needs sound training in science and mathematics. But the schools in your town may not be giving it to him. Many—perhaps most—U. S. public schools do not. There's nothing your youngster can do about it. But you and your neighbors working together can do a lot.

You don't have to be an educator or scientist to size up the science and math instruction in your school. It takes only common sense and some facts to tell the difference between good teaching and bad.

Enlist the help of the Parent-Teachers Association and other groups in your town—and don't be afraid to ask the questions suggested here. Good schools welcome your interest, give you straightforward answers, admit weaknesses. Poor schools fumble not only in dealing with youngsters but with parents as well.

What to ask. Grade your school on nine major points and you can fill out the PS "report card" (p. 92) that reveals where you stand on science instruction. The points:

- Are the right courses offered?
- How many students enroll in them?
- How effective is guidance?
- How competent are the teachers?
- How are the laboratories?
- How up-to-date are books?
- How is science made interesting?
- Are national standards met?
- How well do its graduates make out?

You may be shocked at what the report card shows for your school. Science teaching in much of the U. S. today is inferior. But to correct faults you must find them. Here's how to do it.

Courses. First off, your youngster has to get the right subjects at the right times. The standard curriculum nowadays goes like this:

Grade	*Science Course*	*Math Course*
7, 8	general science	arithmetic
9	general science	algebra
10	biology	plane geometry
11	chemistry	intermediate algebra
12	physics	solid geometry, trig, or advanced algebra

Notice the absence of science before

Next month: Science Labs

How good are the science labs in your schools? They're essential to the education of your youngsters. But because they make heavy demands on budgets and teachers, they are often slighted. Next month, PS will report on ways to size up the lab situation in your school system.

PHOTO BY W. W. MORRIS

Report card rates your school's science teaching

	EXCELLENT	GOOD	PASSABLE	FAILING
1. COURSES				
2. ENROLLMENT				
3. GUIDANCE				
4. TEACHERS				
5. LABORATORIES				
6. BOOKS				
7. SCIENCE-MINDEDNESS				
8. ACCREDITATION				
9. GRADUATE PERFORMANCE				

KEEPING SCORE: If your town's schools rate good or excellent on six or more points, they're fine. With four good or excellent marks they're trying but not hard enough. Less than four means your youngsters are being deprived of science training. The accompanying article explains how to evaluate each of the points.

grade 7. Most elementary schools only give a taste of science in reading or social-studies courses. Many educators believe that they *should* be teaching elementary science each year along with the three Rs.

To rate as "passing," your school must offer at least the minimum "standard" science-math curriculum. Most large schools, covering the bulk of U. S. school children, do. According to the U. S. Office of Education, 89 percent of high-school students have the opportunity to study advanced math, 93 percent can study plane geometry, 97 percent can study biology and 94 percent can study either physics or chemistry. Youngsters who attend small schools are not so lucky. They make up a small percentage of all students, but still a large number. About 400,000 youngsters, for example, attend those high schools that lack either physics or chemistry.

Don't be content with a mere list of courses. Find out if they are presented in a planned sequence from kindergarten on. This avoids rehashing the same material in different classes, and aims for logical development of knowledge. Third graders should learn *some* algebraic concepts, for example. Math should be closely geared to science courses.

Any principal will tell you he's all for such an integrated study plan. Ask to see it. Unless it's in writing, it's useless. Boost your schools' grade a notch if they do use a written study plan.

Enrollment. Today, more kids than ever study science—but they're still far too few. While 73 percent of 10th graders study biology (required in many schools), only 32 percent of 11th graders take chemistry, and a small 23 percent of 12th graders take physics.

What are the figures for your school? Unless they're considerably above the national averages just noted, the science enrollment rates only "poor" to "fair."

Guidance. Many educators say that all youngsters should take at least two years of science and two years of math in high school. And a student interested in becoming a scientist, engineer or technician in any field needs *every* science and math course in the curriculum. Most youngsters don't know this and need help in picking courses that jibe with abilities and vocational plans.

Who tests and advises pupils in your school? The adviser should have a knowledge of science and be acquainted with job requirements in technical fields. Yet only one in 10 school counselors has any science background.

Your school gets a "passing" mark on guidance if each student has access to at least one science-trained counselor.

Teachers. This is the squeeze. The number of children to be taught has increased by a fifth since 1950. In that time, the number of newly certified science teachers has decreased 50 percent. "In science there are more part-time teachers than full-time ones," says Atomic Energy

Commissioner Lewis L. Strauss. "One-third of our youngsters are studying mathematics under instructors not qualified to teach it."

How can you tell if a science or math teacher is well qualified? Use the same bases good schools use when hiring him:

Does he know his subject? A high-school science teacher should have a master's or doctor's degree *in his subject.* A grade-school teacher should have at least a bachelor's degree.

Is he certified? And to teach science or math, not some other subject.

What's his teaching record? Find out how long he has taught science and math.

Does he keep up with his profession? It's a good sign if he belongs to a professional organization such as the National Education Association or National Science Teachers Association, and attends its conferences.

Is he continuing his education? Unfortunately, 80 percent of science and math teachers are so poorly paid that they have to work summers. But 24 universities now offer summer jobs as research assistants in science labs. Summer workshops are also offered by the National Science Foundation, General Electric, Westinghouse, Shell Oil and other large corporations. A good teacher also "follows the literature" in his field.

How does his class score on standard achievement tests? In better schools, each class is tested in each subject to see how it stacks up against the national average. Ask the principal to show you scores for the last few years. They should be considerably above the national average, which is very low.

Is he enthusiastic? This is most important. If possible, visit the classroom and see for yourself. One clue to an enthusiastic science teacher is the number of his students who enter (not necessarily win in) science fairs, essay contests and other extracurricular science events. Another clue is the popularity of his class.

If your school officials say they just can't get qualified teachers, find out if the officials are doing their part:

Are they paying enough? High-school teachers nationally average only $4,600 a year. Your school should offer more than the going rate in your area, which may be different from the average.

[Continued on page 228]

Coming soon: A new kind of high-school physics

HIGH-SCHOOL physics, as presented today, is no good. That, in effect, is what a committee of distinguished scientists reported after a hard look. (They couldn't find a single textbook that they considered adequate.) So they are completely revamping the teaching program for this important foundation of science and engineering.

The group, sponsored by the National Science Foundation, includes practically every famous physicist you ever heard of. Actual spadework is being directed by MIT's Jerrold R. Zacharias (radar, A-bomb, atomic clock). Zacharias plans to produce a complete package that will enable high-school teachers to present physics as the committee thinks it should be given. In the package:

- A radically different textbook that starts with atoms and leans heavily on basic principles, skipping elementary applications (like the lever) that take too much space in present books. With the text goes a separate manual for the teacher.
- Paperback books to supplement the text, so that students can follow up aspects that intrigue them.
- Movies to show kids things they mightn't see otherwise—eclipses, for instance. No amateur jobs, these will cost $2,000,000, get Hollywood polish from Frank Capra and Walt Disney.
- A laboratory program that gives a taste of real experimentation instead of making pupils repeat cook-book exercises. They'll make much of their own apparatus (from razor blades, auto tail lights, rubber bands and the like), just as research scientists often do.

Work on the new physics-teaching package is already well under way. An experimental version of the textbook is being tried out now in a few high schools.

Huge Tunnel Built Like a Double-

UNDERWATER PORTION of Baltimore tunnel consists of 21 twin-tube sections of record size, each 300 feet long, joined end to end. Above, one of the giant sections is being assembled on land, before being towed to site and sunk to resting place in river-bed trench. *(Photo: Steelways)*

Largest of its kind ever attempted, a vehicular tube soon to span Baltimore's harbor will top the boldest feats of its famous engineer-designer

Barreled Shotgun

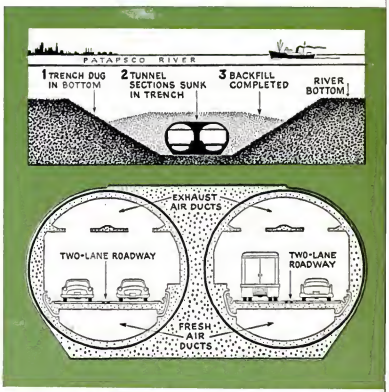
By Ira Wolfert

SOMETHING big is about to happen in the staid old city of Baltimore. Here is a preview: A broad express highway speeds you over railroad tracks, canals and city streets through downtown Baltimore toward the harbor. Suddenly the pavement dips, swoops toward a great portal. "Turn out your lights," a sign commands. You do, and drive into a chamber of many wonders. It shines with a pearl-colored light.

Overhead, ocean-going vessels pass by. At some points, the thrashing of their propellers is not much more than a ceiling's height above you. Yet they might be on another planet for all you know of them. You are in an incredible structure, the new $66,000,000 tunnel under Baltimore's harbor. When the 17½-mile throughway of which this tunnel is a part is opened to traffic next December, you will be able to drive through Baltimore, which used to be one of the worst traffic tangles impeding north-south traffic, without running into a single cross street—or ship.

With Baltimore's, there are now 16 automobile highways that go underwater for distances great enough to require tunnels rather than underpasses—one in England, one in Belgium, one in Holland, one connecting Canada and Michigan, the rest entirely in the United States.

The man who made these fantastic constructions possible is Ole Singstad, once a Norwegian farm boy, now a resident of New York, where more underwater tunnels have been built than in the rest of the world combined. Ole—as he is called by all but his closest associates, who call him Mr. Singstad—designed the oldest underwater automobile highway, opened 30 years ago to connect New York and New Jersey. He has spent the last three years putting together the newest. In the intervening years he has designed, built, or been consulted on almost every great underwater highway that has been constructed or proposed. Recently he was informally approached for advice by persons representing American interests in the proposed Channel tunnel between England and France.



TRENCH METHOD (top view) dispensed with shield to build 7,650-foot Baltimore Harbor Tunnel, carrying four lanes of traffic in twin tubes made by joining sunken sections (lower view).

In 1919, when Clifford M. Holland undertook the task of building the first automobile tunnel, even so far-questing a moon-shooter as Thomas A. Edison felt there was no way to design a tunnel that would be safe for motor traffic; gasoline fumes would pile up dangerously in an enclosed underground space. Singstad, then 37, was still a relatively unknown

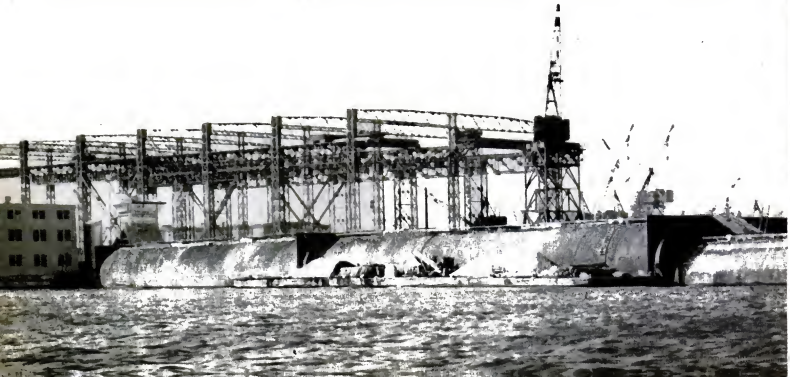
With mighty splash, completed tunnel section—sealed at ends—slides down ways into water.

engineer. But Holland had once built a New York subway tunnel from Singstad's designs. He went to him and said, "Design an automobile tunnel for me!"

Singstad hesitated. While he was thinking about it, he went for a ride on the ferry across the Hudson River. As the boat approached Canal Street, the site of the New York end of the proposed tunnel, he looked across the wide stretch of water to Jersey City. How could he lick the problem of ventilation in a traffic tunnel under the river bed?

A tunnel for electric trains is relatively simple to ventilate, for the train itself acts as a piston—pushing the air out ahead of itself, drawing it in behind. Nor do electric trains give off carbon monoxide. Singstad knew what he was in for, but the challenge of designing a high-

Floating tunnel sections ride progressively lower in water as concrete is added. When buoyancy



way under the deep Hudson River bed—and making it safe despite hundreds of gasoline motors belching a flood of murderous fumes—was too great to pass up.

The U. S. Bureau of Mines made a prototype tunnel for Singstad; cars and trucks were run through it at varying speeds, grinding up grade, coasting down, and their exhaust gases were measured. Yale University built a brick garage for him, jacked up a flivver and substituted propellers for the rear wheels. Then volunteer students, carefully watched and tested, breathed the fumes in precisely measured doses. At the University of Illinois experiments were conducted with fans and ducts.

The answer was finally arrived at: A human being, they found, could safely tolerate only four parts in 10,000 of carbon monoxide in air he breathes for one hour. Singstad had to assume that motorists might be in the tunnel as long as 45 minutes. This meant that wind would have to be blown through the tunnel at 60 miles an hour, sucked out at the same rate. But winds of such force would be a hazard in the tunnel. Furthermore, there was the question of fire. What happens when you fan a gasoline fire with a 60-mile-an-hour gale?

Singstad pondered the problem, then designed a tunnel three floors high. On the main floor would be the highway. Underneath would be a cellar through which fresh air could be blown at high velocity. The third floor would be an attic through which the heat and gases could be sucked out as fast as they rose. To enable the structure to inhale from one hurricane and exhale into another, he cunningly designed openings onto the enormous winds above and below. On the main floor he controlled the air currents rising from cellar to attic. They had to be mild and yet strong enough so that in the case of a fire, when the cars stopped moving, the air would go straight up, confining the fire to roughly the space of a single car length.

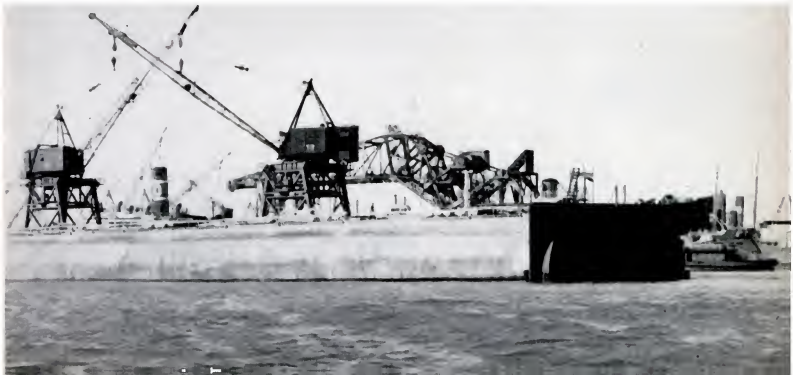
The new-style tunnel solved the ventilation problem, but created another one. The three floors together made a tunnel larger than any ever attempted before under the Hudson.

All tunnels under the Hudson are shield-driven. A tunnel shield is a great metal cylinder, hollow, with a diameter slightly larger than the tunnel's. As it is driven forward by huge hydraulic jacks, earth is removed through it and the tunnel is erected inside it, ring by ring. The tunnel progresses like a worm eating its way through the earth.

To balance the pressure of the immense tonnage of the water above, compressed air must be pumped in. And the pressure has to be calculated to a nicety; too little might let the Hudson come tumbling in the bottom of the shield, too much might blow the dirt out of the shield up through the water.

In building the Holland Tunnel, Singstad had to use four shields. Among other things he had to deal with the fact that the shields could not travel on a straight line. At the banks of the river each pair had to be tilted to cut their way down-

is reduced just past the zero point, derricks lower the tunnel section to bottom. (*Photo:* Steelways)



ward, creating great variations in pressure.

Holland died before the tunnel was half done—of overwork, say his associates—and Milton Freeman, who succeeded him as Chief Engineer, died three months later. The job of bringing the blueprints to life fell to Singstad.

The official opening was on November 12, 1927—a Saturday, chosen because commercial traffic would be light. The ceremony was held at four p.m., but the tunnel authorities, made nervous by dire predictions about the new structure, would not allow cars through until midnight, when they could be sure traffic would be at the lowest ebb.

The speeches over, Singstad walked into the tunnel alone. Suddenly he was conscious of a shuffling sound in the distance. It was like an ocean that had broken out to search its way through a city. The sound became a roaring and he jumped to the elevated sidewalk in alarm. But in a few moments he realized that the sound was coming from the people for whom he had built the tunnel. Prevented from driving through it, they had parked their cars and were walking—a three-mile round trip. Women were carrying babies in their arms, he remembers, and an army of citizens filled the tunnel from side to side. Racing in the van was a legion of small boys, hooting, howling, leaping to bugle the joy and wonder that everybody felt at being alive under a river.

DESIGNER of the Baltimore tube is Ole Singstad, dean of U. S. tunnel builders.
(*Photo:* Engineering News-Record)

Singstad's Holland Tunnel design of more than 30 years ago is still the standard.

Now he is pioneering again—in Baltimore harbor.

Baltimore wanted two tunnels, each 7,650 feet long, each carrying two lanes of traffic in opposite directions. Singstad and his engineers made calculations and discovered that the job would be like building two sets of five Empire State Buildings, bolting them together, and burying them in the bed of the harbor. More than 5,200,000 tons of earth would have to be removed, and in their place would go 38,000 tons of steel, 1,300 miles of electric wiring, 585,000 tons of concrete. (The Empire State Building in its entirety weighs only about 365,000 tons.)

Singstad decided that millions of dollars could be saved by dredging a trench in the river bed and laying a prefabricated tunnel in the trench, instead of driving a shield under the bottom. Trench tunnels are rare but not new. As far back as 1925, Singstad had been consulting engineer on the first automobile trench tunnel—the Posey Tube under the Oakland, Calif., estuary.

Depending on several things, he explains, the trench method may or may not be the more economical. Current too swift for safe handling of the large and heavy trench-tunnel sections, which must be floated to their sites and sunk into place, would be one factor favoring a shield-driven tunnel; others include heavy harbor traffic, and prevalence of fog, both causing risk of collision between ships and floating tunnel sections.

At Baltimore everything favored a trench tunnel. But none the size of the proposed Baltimore Harbor Tunnel had ever been attempted.

Success in building a trench tunnel depends on achieving what soil mechanics call 'the angle of repose." If you dig a trench in the earth and make sure the sides slope down to the bottom at the proper angle, you need no wall to keep the trench from falling in. Each type of soil has a different "angle of repose," and if you respect it in your digging, the trench can go to any depth, can be filled with water and the water ridden over by ships, heaved around by storms, shoved and roughed up by floods and hurricanes. The earth in the sides of the trench will remain motionless, and the trench itself will stay put.

[Continued on page 262]

Sizing Up Those New Little GM Imports

Britain's Vauxhall Victor and Germany's Opel Rekord join the foreign economy-car parade

By Erik H. Arctander

FINALLY impressed by the upward climb of European car sales in this country, General Motors a few weeks ago jumped into the business with both feet. Vauxhall Victors, made by GM's British subsidiary, rolled into Pontiac showrooms; Opel Rekords, from its West German branch, showed up at Buick dealers.

GM styling gives the Victor and Rekord an American appearance that lets them blend easily into the U. S. automotive landscape. But under the sheet metal perk engines that deliver strictly European economy.

Both cars have short-stroke, four-cylinder overhead-valve engines that turn up a bit more than 50 hp. They scoot along at a 75-m.p.h. maximum and get

Detroit styling gives the Vauxhall Victor's English sheet metal a strong American accent.

OPEL CARAVAN

LAST-MINUTE STYLE CHANGES lowered, widened and lengthened the original Caravan station wagon and Rekord sedan bodies for U.S. sale. Now they're slightly larger than the Victor.

about 30 miles on a gallon. Larger than the Volkswagen, smaller than the Rambler, the two cars are within inches of each other in such dimensions as wheelbase, length, width and height.

GM is aiming at an $1,800 price tag on them. Whether this wishful plan succeeds depends on which accessories the Pontiac and Buick divisions make standard and which optional.

Driving the Vauxhall Victor, first of the cars available in this country, is like driving a pint-sized Detroit product with a British accent. You turn the ignition key to start (there's a manual choke for cold weather) and the engine fires so quietly you barely hear it.

First gear is in the usual position on the steering column. The car steps out briskly in that rather high ratio (3.19:1), winding up to 20 m.p.h. if you let it. Not until then does the engine's protest break through the excellent soundproofing. Second, also high at 1.64:1, doubles the pace to 40 m.p.h., and the top gear, a direct drive, pushes the needle to 70 without fuss. Anything more takes time. The Victor needs 18 seconds to accelerate from zero to 50 m.p.h.

On the low-speed side, the car will putter along happily at 15 m.p.h. in high —on level ground. Hills, however, are as much of a chore for the Victor as they are for other small-engined imports. Still, the 2,188-lb. Victor has it over most of these: Its 55-hp. engine pulls only 40 pounds per horsepower—compared, for example, with the Volkswagen's 45 (1,609 lb. and 36 hp.).

Steering is light and quick (only 3.8 turns of the wheel lock-to-lock, compared

Side-by-side figures show how new imports stack up against each

OPEL REKORD

Engine displacement (cu. in.)	90.8
Compression ratio	6.9:1
No. of cylinders	4
Curb weight (lb.)	1,995
Overall length (in.)	167.1
Wheelbase (in.)	97.9

VAUXHALL VICTOR

Engine displacement (cu. in)	92
Compression ratio	7.8:1
No. of cylinders	4
Curb weight (lb.)	2,188
Overall length (in.)	166.5
Wheelbase (in.)	98

WRAPAROUND WINDSHIELD, fender lines and wheel openings put GM stamp on Victor. These plus liberal chrome, sculptured body panels and bumper design make it look at home in U. S.

with Chevy's 5.3). The brakes haul the car up sharply and smoothly—thanks, probably, to a racing-type layout that uses two cylinders with two leading shoes on each front wheel. Rear brakes follow the usual leading- and trailing-shoe arrangement with a single wheel cylinder.

You can throw the Victor around a corner with more assurance than most American sedans. But several of its smaller competitors corner with less body lean. Firm suspension gives the car a solid, though comfortable, ride; conventional coil springs are up forward and leaf springs aft. Anti-roll bars on the front end help dampen sway.

Visibility is something the Victor has plenty of, thanks to large wraparound windows front and rear. A really spacious trunk makes up for rear doors that don't open quite wide enough to load

INSTRUMENTS AND INDICATOR LIGHTS are grouped around the speedometer for easy viewing. Short-throw manual shift and turn-signal lever are on the steering column. The heater-defroster works fine, once you figure out how to operate it: An under-dash toggle switch turns it on or off. Other controls are also unmarked. Clutch and brake pedals are suspended.

other and smallest Chevy

CHEVROLET ONE-FIFTY

Engine displacement (cu. in.)	235.5
Compression ratio	8:1
No. of cylinders	6
Curb weight (lb.)	3,416
Overall length (in.)	200
Wheelbase (in.)	115

SPACIOUS TRUNK is larger than on most small cars. Counterbalanced lid opens easily, fits well, but may take a strong arm to close fully.

large bundles or baby gear through. Head- and leg-room match Chevy measurements; but in either seat two's company, three's a crowd—Victor lacks 10 inches of Chevy's hip and shoulder space.

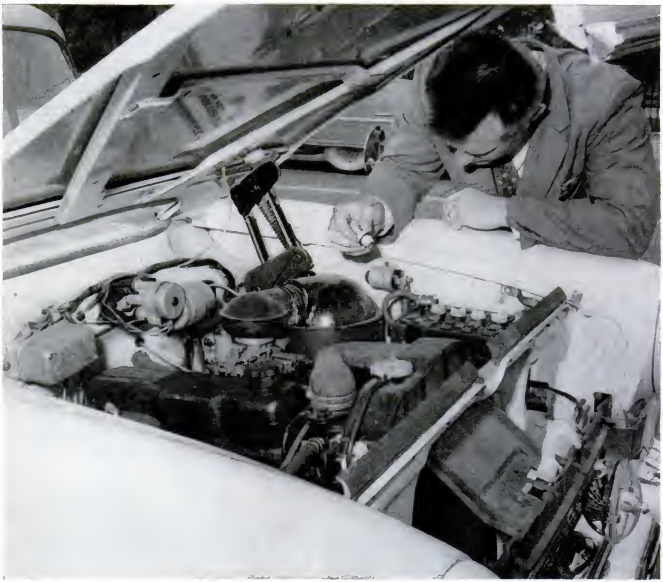
The Opel Rekord has been face-lifted for its American debut. It sports a Buick-style spear along its flanks. Front and rear windows have been wrapped around farther and the dash has been brightened up. A squatter air cleaner fits under the newly flattened hood; otherwise the engine remains unchanged. Re-design added 11 pounds to the Rekord.

With slightly less displacement and a lower compression ratio, the Rekord engine puts out 51.3 hp. compared with the Victor's 54.8. The Rekord, however, weighs in 193 pounds lighter. This helps explain why it gives 34.6 miles to the gallon at 35 m.p.h., somewhat better than the Victor's 29.2 m.p.g. at 30 m.p.h.

Like the Victor, the Rekord boasts a big trunk, double leading brake shoes on the front wheels, coil-and-leaf-spring suspension, three synchro-meshed speeds, 5.60 by 13 tires, 34-foot turning circle.

There won't be much to choose between the two newcomers except styling—until they can build their own American reputations. Establishing a name will take a while, since first shipments are planned at the rate of 1,000 each per month. Shipping shortage or demand from other countries could cut this sharply.

Dealers in the North Atlantic states will be supplied first, then those on the West Coast and finally those in between. With 4,000 Pontiac and 3,500 Buick outlets in the country it may be some time before Victors and Rekords percolate around generally.



SMALL AND UNCROWDED by American standards, engine compartment is almost empty on the right side, except for a windshield-washer bottle. Battery is 12-volt; air cleaner overshadows the engine. A trouble light is clamped on the hood for fix-it-yourselfers. END

Will Space Travel Lengthen Life?

You may have seen the advertisement above in an issue of (appropriately) *Time* magazine. Why should Martin pay $12,500 to pose such an esoteric question to the public?

The reason is that the problem of speed vs. time no longer is a matter for Einsteins. With rockets and satellites bristling all over, it becomes practical to know for sure whether time (hence life) is affected by speed.

The answer seems to be a definite yes.

The faster any material body travels, the longer its life span by terrestrial standards. At a speed of around 160,000 miles a second, you could take a space flight lasting 10 years by earth reckoning, yet age only five years. If you could travel at essentially the same speed as light, you could make a round trip through the universe in 42 years; the earth meanwhile would have spun through *four billion years.*

Dreamers and story writers suspected this long before Einstein "proved" it. A century ago, for example, novelists were concocting plots in which people fled the earth so fast that they caught up with history. In one French brainstorm, the hero's soul was transported to a star 70 light years away. When it landed there (this was in the 1860s), the star's inhabitants—who could observe the earth—were busily watching the French Revolution of 1793. The light rays from that bloody event were just getting there.

What's wrong with all such fictional concepts is that:

- *Nothing tangible can travel faster than light* (186,000 miles per second), so—
- *Chasing the reflections of history isn't what enables you to beat the clock.*

What does happen, though, is this:

- *An increase in speed slows time.* The faster a clock moves through space, the slower its works run.
- *As this happens, all physical, chemical, and biological processes slow down.* Your watch and your heart tick more leisurely. You wouldn't be aware of it on an interplanetary flight, because your environment would ease up in synchronization. But once back to earth—with its slower speeds and faster time—you'd be shocked at how much had happened while you were gone.
- *The direction of your ultra-speedy journey doesn't matter.* You don't have to fly straight away from the earth to invoke the phenomenon. You could do it just as well coming toward the earth—or whirling around it, for that matter. It's speed that counts.

Lately scientists have tested the theory physically with a clock. They couldn't whirl a Big Ben around in space, of course, but they did have a handy substitute—the meson.

Mesons are tiny particles of matter that cosmic rays create high in the atmosphere and send shooting to earth at exceedingly high speed, near the velocity of light. Mesons are clocks because they "decay"—change into other particles. How long it takes them to decay—their normal life-rate—has been measured.

Does a moving meson decay slower than a stationary meson? Does its speed of motion make its life-clock slow down? Scientists compared the lifetimes of fast-moving and stationary mesons. The conclusion: yes. A meson in flight lives about 15 times longer than a meson at rest.

You can indeed put the brakes on time.

When the veils are snapped off Chrysler Corporation's 1958 cars this month, the focus of interest among mechanically minded viewers will be a revolutionary new engine. Here are the facts—how it came to be, and why

The Inside Story on Chrysler's New V-8

COUPLED to the black bulk of the dynamometer was 638 pounds of new engine, a compact V-8 on which rode a multimillion-dollar gamble. Lab technicians and engineers caught their breath as the starting button was pressed for the first time.

The engine fired, and stalled. Again it was cranked. This time the engine caught, settled down to a brisk idle. Eyes went to the gauges. Ears strained for piston slap, faulty tappets, the first audible hint of trouble. A skilled hand cracked the throttle wider.

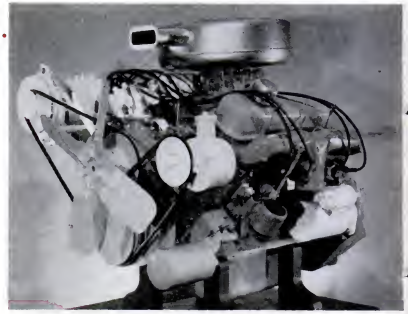
Chrysler's new "B" engine, crash-programed for its 1958 cars, was making its first test run. For five tense minutes the men who had created it studied its pulse.

Then, with one mysterious cough, it quit—and refused to start again.

This was the crusher that followed months of taut effort beginning in January, 1956. It was then that Chrysler brass had told its engine-development team: "We need a new engine for the 1958 Dodge and De Soto. It has to be lighter but pack more horsepower than our 1957 engine. It must be easier to service, more economical to build. You've got 18 months to get it into production."

Usually it takes three years to design, test and tool up for a new engine. "This one," says Bob Rarey, Assistant Chief Engineer for engine design, "we began tooling while it was still only on paper."

The deadline was met. By June of this year the "B" engine started rolling off the production line. Yet it has more radically new features than any engine in Chrysler history.

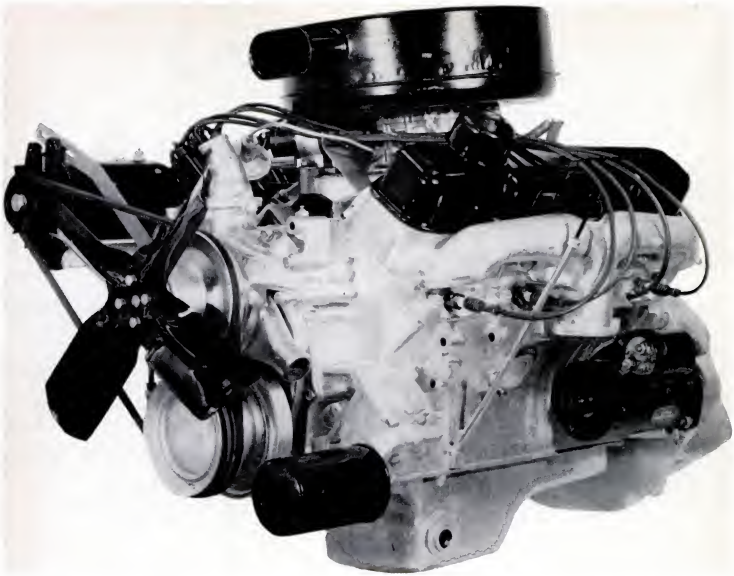


WHICH ENGINE IS THE REAL ONE? A wooden mockup (above) helped Chrysler engineers plan

Why make a new one, when retooling costs millions? Because there are limits to improving an engine you already have. From 1953 to 1957 the displacement (and so the power) of the Dodge engine was pushed from 241 to 325 cu. in. It was done by boring the cylinders bigger (which meant reducing wall thickness and water-jacket space) and adding an inch of metal to the top of the block.

This extra cylinder length, plus a retooled crankshaft, increased the stroke and thus further boosted displacement. But it sacrificed the big advantages of an oversquare engine—one with a bore bigger than its stroke. A short stroke cuts piston friction. A relatively large bore gives you room for big, fast-breathing valves. It was, Chrysler decided, time for a new engine.

Basically this was to be a high-com-



the placing of the many accessories that festoon any modern automobile engine. White unit on the mockup but not on the actual engine (shown on this page) is the power-steering pump.

pression, oversquare V-8. As soon as the cylinder centers were laid out on paper, boring machines were ordered. The new block was given a deep skirt extending well below the main-bearing centers. This made it more rigid, permitted a shallower oil pan that is easier to press—and to take off for servicing.

A flange was cast on the block to eliminate the aluminum adapter formerly required for mounting the torque converter. That saved an expensive extra part as well as the work of attaching it.

"But what happens to your horsepower-to-weight ratio with all that extra iron in the skirt and the flange?" I asked.

"We save weight in the new heads," Rarey answered. "They account for a lot of poundage in our older engines."

Different is the word for these cylinder heads. In them, Chrysler has at last dropped its domed combustion chamber.

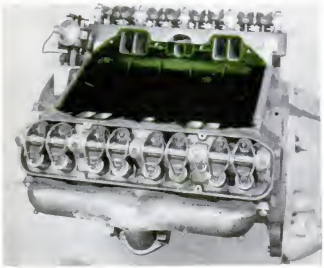
To boost compression with a domed head, you'd have to either put a dome top on the piston (which is costly, adds reciprocating weight) or flatten the dome curve, which would cut down on valve space and alter the ideal shape of the chamber anyway. Instead, to get the 10:1 compression ratio wanted, the chamber was made wedge-shaped and only about two-thirds as large as the cylinder area.

This shape makes it feasible to put the valves in line, with their rocker arms on a single shaft instead of two (as required for angled valves in the domed head). On a V-8, that saves two parts.

Big water passages run close to the valve seats and stem guides. But the new head contains only one-third as much water as that of any comparable engine. To make it cool adequately, Rarey's team planned a reverse series flow.

From the pump, water was to enter the front of the block, flow through the cylinder jackets, then pass up into the head

VALVE ROCKERS ARE NEW, the first stamped ones in Chrysler history. They bear only on the underside of the rocker shaft. Oil feeds from inside the shaft to rod sockets and valve stems at ends of arms, then drains off the top of the head back into the tappet chamber.



NEAT TRICK. Intake gaskets are a single piece (color) that covers the tappet valley, eliminating a separate cover and mounting ledges.

at the rear of the block. From there it would be forced forward at high velocity through the head passages. This water-flow scheme was a calculated risk. If cooling proved faulty, the entire head design and much expensive production tooling would have to be scrapped.

"Let's stamp rocker arms to save machining," the big brass said. In former engines, valve-rocker arms were malleable iron castings, which had to be bored, bushed and radiused where they seated against push rods and valve stems. The engineers drew up what they wanted. Stamping experts had to learn a few new tricks to form the bathtub-shaped arms.

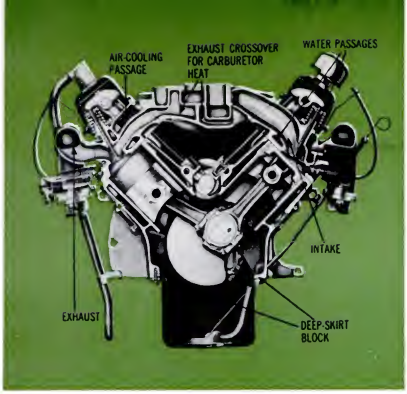
Squeezed to shape from an almost circular piece of metal, these have an accurately formed bearing surface that pivots on the underside of the rocker-arm shaft (because of valve-spring tension, all the load is there, none on top). At one end of the arm, a socket houses the push rod. The other end is radiused two ways to bear on the valve stem.

Oil pumped into the shaft is released from holes above the arm bearings. Supposed to flow toward both ends and lubricate the push-rod and valve areas, oil spilled off until the stamping was redesigned with lips at strategic edges.

Meanwhile stamping techniques were being improved to make the bearing surfaces more perfect. But these proved to be too good: They fitted on the shaft so well that oil could no longer feed out of it. The solution: shallow grooves leading from the oil holes.

Earlier, engines had long—and expensively drilled—drain holes in the block to lead oil from the rocker chambers back to the crankcase. The new heads let oil drain off the top back into the tappet chamber. Net gain: no drilling cost, no blocks spoiled by wandering drills.

The valley between the two blocks of a V-8 is usually closed by a cover. Why not, asked a member of the team, stamp the two intake-manifold gaskets from a single piece of metal and let the section between cover the tappet chamber? This saves another part. It also cuts weight



THE HEART OF IT: New deep-skirt block runs right down to bottom of crank-web swing. Bore of the 350-cu.-in. engine is 4 1/16", of the 360-cu.-in. version 4⅛". Stroke is 3⅜". Reduced cooling-water capacity will make the engine warm up more quickly in cold weather.

and facilitates coring by doing away with the ledges that would otherwise be cast on the block for bolting down the cover.

Stealing a trick from the stylists, the engineers had a wooden mockup of the engine built, and put it into a front-end car assembly.

"That dummy engine was a working tool," said engine design engineer Bill Weertman. "It showed us where we could hang the accessories, and what our clearances were." In Detroit lingo "accessories" are such essentials as the coil, fan, air cleaner and generator, as well as deluxe extras like the power-steering pump and air-conditioning compressor.

When the engine quit on its first run, engineers and lab technicians conducted a glum post-mortem. The distributor-oil pump shaft had seized, shearing the pin that locked its drive gear on. Repairs were made and the engine again fired up. But almost at once a push rod pierced the socket in its rocker arm and the engine was down again.

Such are the growing pains normal to any newly developed engine. Chrysler licked both these troubles for keeps. The shaft bearing was enlarged; deflection in the oil-pump housing that had caused interference with the oil-pump rotor and so side-loaded the shaft was found and corrected. Stamping and hardening techniques were improved to perfect the arms.

Other problems had to be licked when the engine was running again. It is disquieting to look into the choke well of a carburetor and find it red hot. To remedy it, they had to cast an air-cooling passage into the exhaust crossover supplying carburetor heat. Exhaust manifolds, which usually plague engine designers by cracking in strategic places, stayed in one piece. It was the intake manifolds that broke again and again, until every weak point was found and corrected.

Piston slap, no part of a well-bred power plant, made a clatter while the engine was cold. Working all one weekend, technicians made new pistons to the designers' specs. The slap was stopped. But a mysterious minor chatter gave the team some bad moments. Finally they traced it to the oil-pump relief valve.

"It sort of growled at you," Weertman recalled. "We took the thing apart—just a little cylinder, piston and spring—and stood around trying to figure out what was wrong with it."

The engineering sleuths decided that the piston was catching on the edge of the port at one end of its travel and in microscopic machining ridges left in the cylinder at the other. Chamfering both ends of the piston taught it better manners.

Driveway mechanics will cheer some of the servicing features of the new engine. The distributor is high up in front, within easy reach. You can change the "lamp bulb" oil filter with one hand—just unscrew it and put in a new one.

Horsepower is still secret as this goes to press, but Rarey brags that the engine came through its dynamometer runs with pleasing results. It will be made in a 350-cu.-in. version for the Dodge Custom Royal and De Soto Firesweep, and as an option on all Plymouths. Bored out to 360 cu. in., it will power the Dodge D500, De Soto Firedome, Fireflite and Adventurer. Closest comparison, Rarey points out, is the 354-cu.-in. engine of the 1957 Chrysler Windsor. It has a compression ratio of 9:25 to 1, weighs 721 pounds, winds up to 285 hp.

The new 350-cu.-in. "B" engine weighs 83 pounds less and has a 10:1 compression ratio. Horsepower is being announced this month. It seems a fair bet that it will be 300-plus.—*Harry Walton.*

How They Make a Hot Trumpet

Master craftsmen, using hand tools and power machinery, shape sheets and tubes of brass into fine band instruments

By Harry Samuels
with photos by W. W. Morris

IT TAKES a lot of heat to produce a "hot" trumpet. Hammering, soldering, brazing—even molten pitch—all contribute to the warmth that transforms metal sheets and tubes into a shimmering horn.

Some 2,000,000 Americans who play brass instruments just for fun prefer the trumpet. Possible reason: It's easier to play than the other units of the brass section (trombone, French horn, tuba, mellophone, etc.).

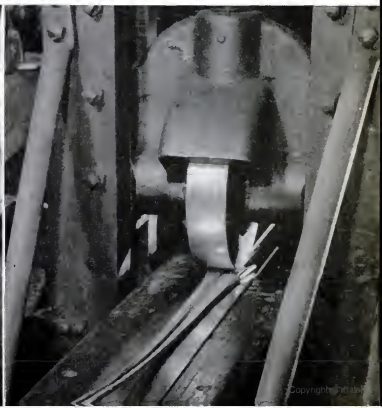
Trumpets sell for as little as $75, as much as $300. One big market as well as a big headache is provided by more than 60,000 U. S. school bands.

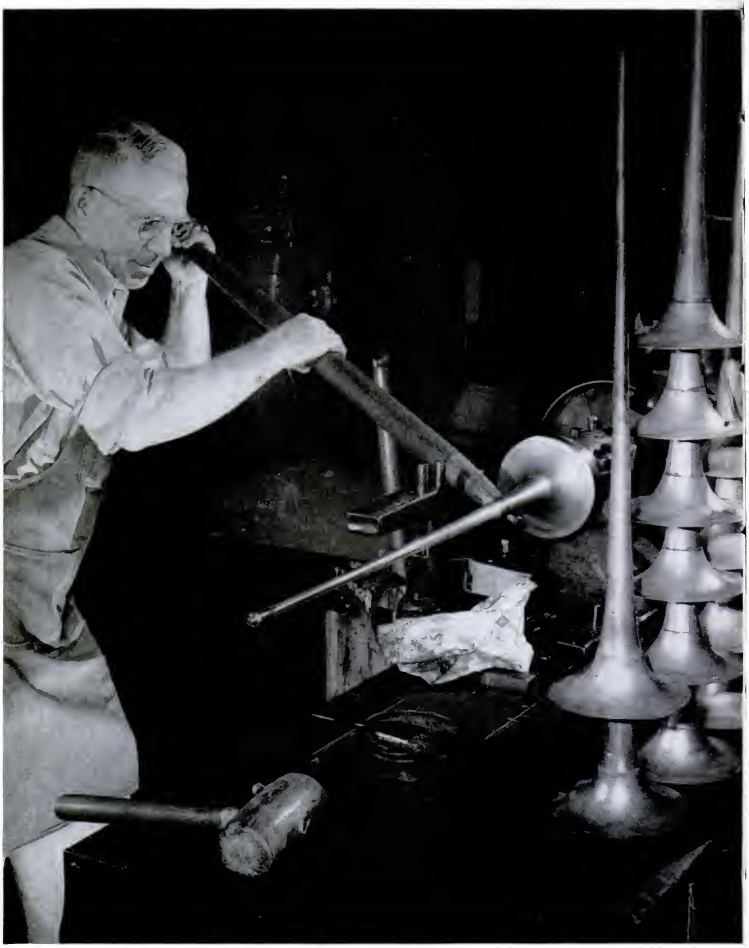
The headache comes from a teen-age habit of downing a soft drink and candy bar just before band practice. Result: sticky valves. In the C. G. Conn plant in Elkhart, Ind., where these photographs were taken, professional musicians test-play every trumpet made. To simulate the rough treatment horns may receive from teen-agers, the musicians guzzle pop and munch candy between toots.

By means of eight possible positions of the three valves, plus lip-and-breath control, a trumpeter can play two and a half octaves containing all the tones in a chromatic scale—the middle 30 black and white notes on the piano, plus a few in the cracks. The trumpet's brilliant tone makes it a preferred instrument for dance bands.

It changes from flat to round and back again

TRUMPET STARTS OUT as a triangle of sheet brass with curved sides. Hammered around a forming bar (below, left) it becomes a tube. The seam is brazed and the tube is rolled in a press (below, right) to smooth the rough joint. Another forming bar is used to bring the flattened tube back into the round again. The bell-shaped flare, which provides the delivery end of the trumpet, is stamped from sheet brass and silver-soldered to the tube. During the soldering operation, extreme care must be taken to maintain an even temperature.





Spinning gives the bell a slick, smooth shape

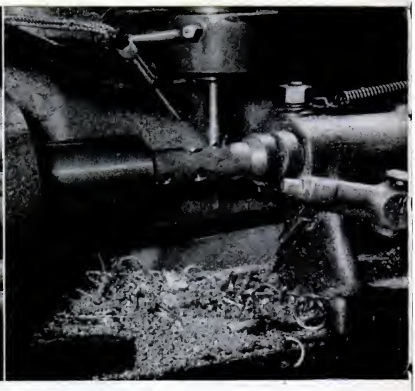
TUBE WITH FLARE attached is called a bell. Spinner, one of many craftsmen needed to produce band instruments, maintains steady force and speed as he squeezes bell over mandrel chucked in lathe. Heavy wooden pole he is using will be followed by a steel burnishing tool.

Hot pitch prepares the bell for bending

MOLTEN PITCH IS POURED into the bell (the small end of the tube is stoppered) and allowed to harden. Solid filling will maintain the critical inside diameter and keep the tube from collapsing during bending operation. Any distortion of the bore affects trumpet's tone.

Adding curves for the music to go 'round in

BELL IS BENT around a special jig (left) while protected by its pitch filling. After bending, the bell is heated until all of the pitch is melted out. Subassembly of tubing and valve cylinders is soldered to the curved bell (right). The trumpet is now ready to be engraved.



Hands and machines perform precise jobs on trumpet

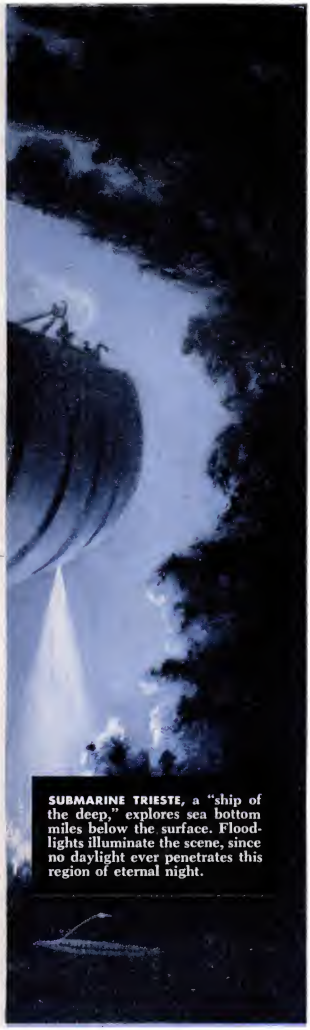
HAND ENGRAVING is a traditional adornment on the flares of band instruments. The design and lettering are transferred to the metal with carbon paper, and a skilled engraver cuts into the brass with hand tools. In the photo at right, above, holes are drilled in the pistons to extremely close tolerance. These will be fitted into the trumpet in the final operation.

Pistons are installed and the horn is ready to blow

TRUMPET IS BUFFED and polished before pistons are fitted into valve cylinders. Otherwise polishing operation might upset the precise fit of the piston within the cylinder. At right Dr. J. C. Hall, chief acoustical engineer for Conn, plays trumpet in a weird test room. Bulging walls and ceiling eliminate parallel surfaces, so that sounds have less echo distortion.

Sweets, soda and skill combine to test trumpet

EVERY TRUMPET IS PLAYED by a professional musician before it is placed in stock. Trumpeters above are shaking down a horn's valve action on a diet of soda pop and candy. They make music eight hours a day and are experts on every instrument of the brass section. Their biggest problem: collecting enough new music to play so the job doesn't become a bore. END



SUBMARINE TRIESTE, a "ship of the deep," explores sea bottom miles below the surface. Floodlights illuminate the scene, since no daylight ever penetrates this region of eternal night.

'Ship of the Deep' Probes Sea Canyons

The Navy plans new adventures for a strange exploring craft that already has gone more than two miles down

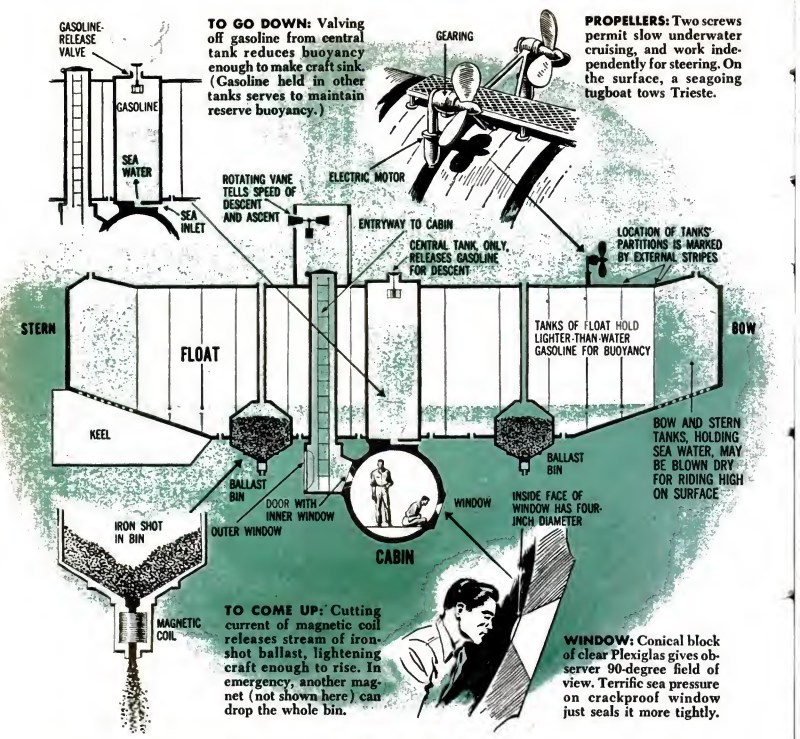
By Alden P. Armagnac

MYSTERIES of the deep will be probed for the U. S. Navy by the extraordinary submarine Trieste, the creation of the Swiss scientist Prof. Auguste Piccard, who has descended more than two miles beneath the sea in its windowed cabin. Just begun under American sponsorship, a series of 15 deep Mediterranean dives will be made off the Italian coast by the zebra-striped craft, as a contribution to worldwide oceanographic research during the current International Geophysical Year.

With Prof. Piccard's son Jacques at the controls, the Trieste will carry a succession of scientists on exciting undersea adventures. They'll cruise right into sea-bottom canyons to explore them at first hand. Their craft will be borne along in the deep-sea currents they want to chart. They'll spy on scientific apparatus that their colleagues lower from the faraway surface—sediment samplers, temperature probes, "bottom corers"—and bring back eyewitness reports on how effectively it works. Studies are planned of "underwater sound"—both the noises made by creatures of the deep and artificial sound signals. To be investigated is a "deep scattering layer" that gives the effect of a phantom bottom, in echo sounding.

Ideally suited for deep-sea observations such as these, the Trieste maneuvers much like a balloon. To go down, it valves off lighter-than-water gasoline. To rise, it drops iron-shot ballast. Both are contained in a hull-shaped float, from which hangs the spherical cabin.

To resist water pressure that would crush an ordinary submarine like an eggshell, the steel cabin has a wall of minimum 3½-inch thickness, increasing to six inches around the two six-inch-



Drawings, highly simplified for clarity, show the Trieste's novel principles and features.

thick windows. These conical blocks of Plexiglas are just plastic enough to form an excellent seal, when forced against their seats by pressure outside. The float is unaffected by pressure, which is equalized inside and out by bottom openings to the sea.

Tanks supply oxygen, and an absorber removes carbon dioxide, while the cabin is sealed for diving. Electric controls, within, maneuver the craft. Floodlights on the float illuminate marine life and the sea floor.

There is only one counterpart of the Trieste in the world—the French Navy's similar FNRS-3, also designed by Prof. Piccard. Since 1953 the world's depth record has seesawed between these two craft; at this writing the FNRS-3 holds it with a dive of 13,287 feet, while the Trieste has descended 12,467 feet. Before their exploits, the record had been a 4,488-foot dive by the undersea explorer Otis Barton, in a windowed steel sphere lowered on a cable. The limit had been set by peril of a cable's breaking, which increased with its length and consequent weight. Piccard removed this limit by doing away with the cable, and inventing an entirely new kind of submarine—the bathyscaphe, or "ship of the deep," as he has named it. END

Who Says Teen-Agers Can't Drive Safely?

North Carolina students like this one are logging a remarkable 50,000,000 safe miles a year.

Tarheel youngsters rack up an enviable safety record as they drive their own school buses

By George J. Barmann

STUDENT school-bus drivers in North Carolina are rolling up a safety record that provides a strong rebuttal to often-repeated charges of teen-age recklessness on our streets and highways [see "Who Are America's Worst Drivers?" —PS, Jan. '57].

This fall, the young North Carolinians are hauling approximately 600,000 of their schoolmates to and from classes. By June, they will have logged another 50,000,000 miles, in all kinds of weather, on the roads that cut through the soft red earth and the high green pines of the Tarheel State.

The teen-age drivers, 7,000 of them, run the largest pupil-driven school trans-

18-year-old bus driver goes to work—on her way to school

HER ROUTE BEGINS AT HOME: Carolyn Smith leaves her house to board the bus she drives herself. She keeps it parked in her driveway.

DON'T FLIRT WITH THE DRIVER: Carolyn greets a pair of fellow pupils with a smile as she stops to pick them up on the way to class.

portation network in the United States. They have given North Carolina—first state to turn over the wheel to youth—one of the best school-bus safety records in the nation.

South Carolina, and a score of other states, notably in the South and Southwest, according to the U. S. Office of Education, are following North Carolina's leadership in some degree. They are developing common sense and responsibility in the hot-rod generation.

Girls, 1,100 of them, are on the North Carolina driving varsity. Their skill and judgment with the bulging, five-ton vehicles astonish motorists, and sometimes school authorities, too.

Perhaps no one in North Carolina is more excited over the consistently good showing of the young drivers than Superintendent James W. Wilson of the Mecklenburg County System at Charlotte. He bosses the state's largest school-bus fleet.

The tall, 57-year-old educator, a civil engineer before he became a schoolman, sends out 193 buses every class day to the schools in his populous district. They carry 13,000 children back and forth each morning and evening, and travel a total of 6,855 miles every 24 hours.

"Well, I declare!" Supt. Wilson said the other day, putting down the telephone in his office in the Mecklenburg County Courthouse. "That was a father, just moved here. He said, 'Mr. Superintendent, I don't understand it. I took my boy to the bus stop this morning and there up behind the wheel of that big machine was a mite of a girl. Why, she couldn't weigh 100 pounds. I don't know if I can let my child ride that bus.' I told him—don't you worry about her size. We just haven't noticed that size has much to do with good driving."

Supt. Wilson has had experience with nothing *but* boy and girl drivers the last 25 years. "I'm not sure I'd want adult drivers," he says. "I've had some school principals, in other places, tell me all kinds of troubles about the adults. Pay is sometimes too low for good ones. The hours are awkward, and they have to sit around between trips. You might have to hire one, say, because his friends insist he needs work. Another, maybe, is retired and wants something to do."

North Carolina does employ adult drivers on school runs, but only about 800. They usually are assigned to roads in the mountainous western counties.

Pupil drivers get $22 a month—adults would expect many times that much—and, as Wilson points out, "The youngsters are going to school anyway. That's $22 they just pick up on the way."

To hold these driving jobs, he says, pupils must be punctual as well as competent. Some of the best ones, it turns

STOP, LOOK—AND BECKON: Beth Orr, 17, waves the driver on after making sure the track is clear —the duty of a designated pupil on each bus.

SHE GETS UNDER THE HOOD, TOO: After the day's run is over, Carolyn performs a little first-echelon maintenance with the dipstick.

out, are among the most popular—and the best-looking—in their crowd.

Early each morning for two years, little Carolyn Smith, a cheer leader and beauty queen at East Mecklenburg High School, has been wheeling her bus from the driveway at home, on the edge of Charlotte, collecting 70 children at stop points and taking them along to classes.

Carolyn, who is 18 and plans to be a secretary, maneuvered her bus into close quarters in the lot at the school after a dozen miles on the road, bounded her 92-pound figure down the steps and told a friend, "You know, I've learned to handle this bus better than the car at home. I can park it almost anywhere."

An honor pupil at East Mecklenburg, sturdy, 19-year-old Dave Bland, has been driving a 15-mile route twice a day. "I've had to get up an hour earlier than the other kids, just like all of us drivers," Dave says, "but I forget that when the check comes in every month." His brother, Jim, turned 16, is driving, too.

Another pupil helping Supt. Wilson's fleet mark up savings and safety is Judy Rock, 17, secretary of the Student Council. Judy, who is banking her driver pay to study nursing, shows honor-roll performance in class and behind the wheel. "The driving test I had to take, though," she recalls, "was as tough as any final."

To win driving jobs, boys and girls have to be 16, the legal driving age in North Carolina. They must have a license with no violations on it. A special state bus-driver's license is issued them after they qualify in a stiff driving test—in a bus—conducted by the North Carolina State Highway Patrol, and a pencil-and-paper examination on traffic rules and safety. And they practically have to memorize a 40-page handbook of good driving practice.

Despite the strict requirements, Wilson says, the pupils compete as though they were out for the school play or the football team.

"We've always got a swarm of applicants," he notes. "We make an announcement in the fall and the principals get up a list to be screened. But just because a boy's on that list doesn't mean he's going to get a bus. The ones we take have to show character and steadiness, not only quick reflexes."

School authorities examine the pupil's background, conduct, habits and achievements, even the kind of personality he has.

"If he has no standing with his schoolmates, he won't be able to operate a school bus for us," the superintendent says.

After a pupil is finally selected, he is enrolled in a special training course with

a staff teacher to prepare for the tests. Wilson often meets with the drivers in his system, and he always warns them against overconfidence.

"I ask them a question," he says. "I say, 'Who is it who generally is drowned in the summer?' They spar around awhile, and it's always amazing to me that they give the same answer every time. They say it's often the good swimmer who drowns.

"It seems to us that some of the best drivers are the first-year drivers. Later on they may get a little too experienced, like the fellow who thinks he can swim anywhere. We try to keep the boys and girls as sharp as they were at the beginning—that's why all this training and supervision."

Coaching from the sidelines, Wilson and his principals demand first-team performance. Every day or so the young drivers and their bosses huddle on bus problems. A driver who breaks the rules is quickly taken off the job. One who needs help gets it.

"A boy came in to see me some time ago, and he said, 'Mr. Wilson, I meet a man every morning on the same curve, and he never will let me share the road. He crowds me. What'll I do?' We told the boy a police cruiser would be at that curve the next morning. Sure enough, it happened again, and they nailed the man. That fellow was acting smart just because the bus driver was a boy."

Drivers are cautioned to stop only at designated points to pick up and unload passengers and to resist any appeals to stop at places more accommodating than safe. "Parents sometimes kick like forty," Wilson says. "They complain, 'Why, it's raining. My boy can't walk that far in that rain.' I told one of these mothers, 'Well, put some clothes on him. We're thinking of his safety, not convenience.' "

One of Wilson's drivers parked his bus in front of a bakery shop and let the children dash in for doughnuts. He was fired the next morning.

Another driver was persuaded by his railroad "lookout," the star basketball player at school, to let him out at a railroad crossing, as usual, and then leave him there after he had checked for trains and waved the bus on. The acquiescent driver lost his license; the other boy lost his lookout job.

Occasionally, the superintendent has to deal with instances of destructive horseplay and downright devilment.

Two drivers dared to pass their loaded buses so close that they knocked the rear-vision mirrors off the sides. Another cocky driver butted his bus into one ahead. His principal hesitated to act because a member of the School Board argued that the boy was going to be a minister and needed his driver pay for his college education. "I'm afraid I can't do anything about firing him."

The superintendent said, "I can do something, my friend. I'm firing him. I can't have a fellow who can't see a great, big bus in front of him."

"I called in one of my girl drivers some time ago," Wilson says, "because she was permitting her boy friend to sit in the seat next to her on the run. I told her we couldn't have puppy love mixed with driving. I said if he cares anything about her, he'll stay in back; if not, she better get another boy friend. She minded me from then on."

The student drivers inspect, sweep out and wash their vehicles regularly, but repairs, when something happens any-

[*Continued on page 236*]

KNOWING that Caleb was slow to pay his bills, Mike set the price for building a fireplace and chimney on his new house wing a trifle higher than usual. Mike finished it in September, but Caleb wouldn't pay. "Why should I?" he asked. "Can't use it till winter, can I?"

But the first cold day he complained bitterly to Mike: "That fireplace is no good. I can see sky through the chimney, but all the smoke gets into the house."

"Bet you the price of the job," offered Mike, "that I can make it draw." Caleb agreed. Mike climbed to the top of the chimney, taking only a brick with him, and came back down in a few minutes. When he built a fire, it drew perfectly. Caleb paid.

...How Come?

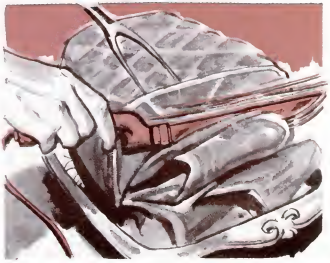
ANSWER: *Mike had cannily cemented a pane of glass across the chimney top. To make the fire draw, he simply dropped the brick through it.*

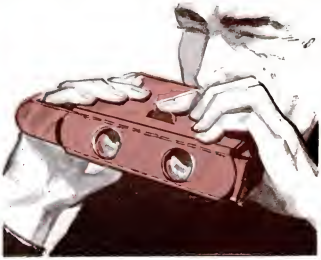
New Ideas from the Inventors

1 Boat Forms Hunter's Perch. Sitting atop the open well of this tiny boat, a rubber-booted duck hunter could float himself and his gear through shallow waters along a lake or river edge. Then, by adjusting the vertical footrest, he could stand upright when he wanted to take truer aim, or to unkink his legs.

2 Electric Knife Carves the Roast. Driven by a small electric motor in the handle, the blade of this carving knife would jiggle rapidly back and forth. The sawing action, the inventor claims, would make meat-cutting easier and result in neater, more uniform slices.

3 Slide Opens Binocular Case. Your field glasses would be fully protected, yet available for quick use, if you carried them in a case like this. Instead of removing them from the carrier, you'd just shift a slide, as shown, to uncover the lenses and form a comfortable hand grip.



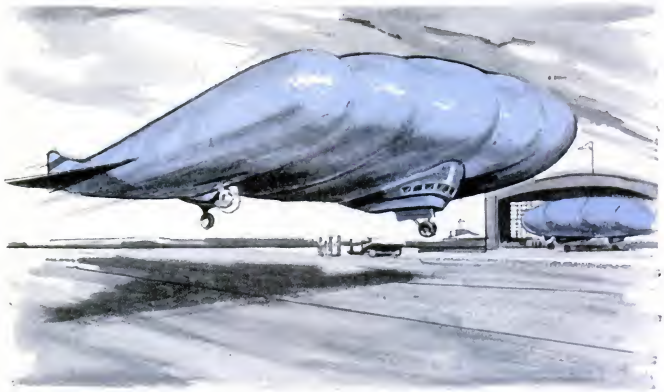


Please turn the page for more new ideas

4 Stickers Tidy Electric Wires. With slotted rubber holders like these, you could arrange dangling lamp and appliance cords so they'd be safer as well as neater looking. A slot in each plug would grip the wire, and an adhesive backing would hold it fast to a wall or baseboard.

5 Handle Holds Pail and Brush. This clip-on, pistol-grip attachment would take firm hold on the rim of a paint can so you could manipulate the can easily with only one hand. And the spring-clip fastener on top would hold your paintbrush in place over—but not in—the pail.

6 Flat Blimp Rises Faster. A flattened or pancake-shaped blimp, says this Goodyear Aircraft patent, would act something like a plane wing and thus allow the craft to rise faster and lift greater loads. Reducing the height of the gas bag would also simplify ground handling by cutting down the effect of winds.



7 Saw Guard Protects Your Hand. You could use the full cutting length of a hacksaw blade without risking skinned knuckles if you had this shield attached ahead of the handle. It would also protect your hand against cuts from snapped blades and sharp, sawed-through ends.

8 Pocket Guards Small Change. Your keys, change and other small objects wouldn't fall out of this trouser pocket, as they often do from an ordinary one. For even when you sat back comfortably in a car seat or soft chair, the things that usually slip out would drop instead into the toe-shaped pouch that forms the lower end of this pocket-within-a-pocket.

9 Mirrors Peer Around Corners. With this pair of front-view mirrors mounted on the hood of his car, a driver could check in both directions before pulling out of a hedged-in driveway or entering a blind intersection. Like rear-view mirrors, they would be individually adjustable to the angle that would suit the driver.

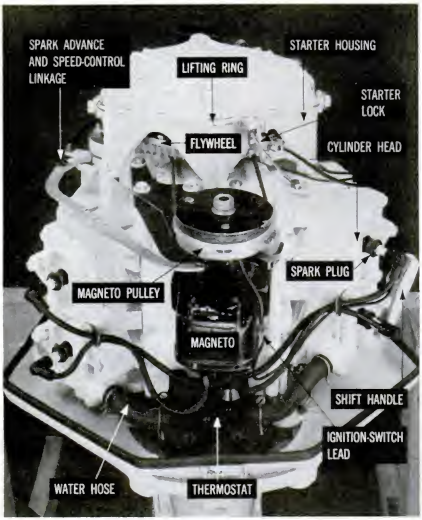
The following patents *have been issued on these inventions: 1. Patent No. 2,747,201 to C. J. and C. R. Erickson, Salt Lake City; 2. No. 2,781,578 to L. P. Guilfoyle, Ridgefield, N. J.; 3. No. 2,780,263 to A. Blumberg, Cambria Heights, N. Y.; 4. No. 2,704,302 to R. W. Budd, E. Northport, N. Y.; 5. No. 2,786,707 to C. M. Campbell, La Grande, Ore.; 6. No. 2,778,585 to D. B. Tschudy, Canton, Ohio; 7. No. 2,660,974 to L. S. Swain, Martinsville, Va.; 8. No. 2,732,560 to J. W. Frederiksen, Sr., Chicago; 9. No. 2,783,683 to E. Maurer, Mulhouse, France.*

Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington 25, D. C., at 25 cents each. To write to an inventor, if the address given above is insufficient, you may address him (by name and patent number) in care of the Commissioner of Patents.

Here is what's new in:

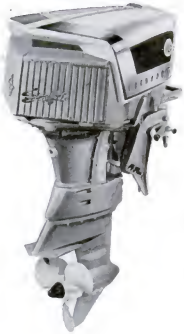
Outboard Motors

A revolutionary V-4 engine, a whopping new six, and a novel 22-hp. kicker are among the designs being



Johnson unveils a V-4 to top its line of Super Sea-Horses with a 50-hp., two-cycle engine in a design new to outboards. Company engineers say the 90-degree V balances one bank of pistons against the other and thus reduces vibration and noise. The engine has a 70.7-cu.-in. displacement, a twin-barrel, downdraft carburetor and a thermostat-controlled, recirculating cooling system. The Super 50 is available either with electric or manual starting.

The Super Sea-Horse 35, a two-cylinder, in-line engine that headed the previous year's models, will come in three new versions, one having most of the 50's features. Six other models are from 18 to three hp.



Evinrude also has a V-4 in two models: Starflite with electric starting and Four-Fifty with standard starting. Both are 50 hp. and built with horizontal-V cylinder blocks along the same lines as the Johnsons.

Features for quiet operation include a soundproof shell, rubber mounts for the powerhead and an exhaust silencer on the Lark 35 as well as the V-50's. The motor cover can be removed in one piece. Spark plugs and the carburetor are reached through a door.

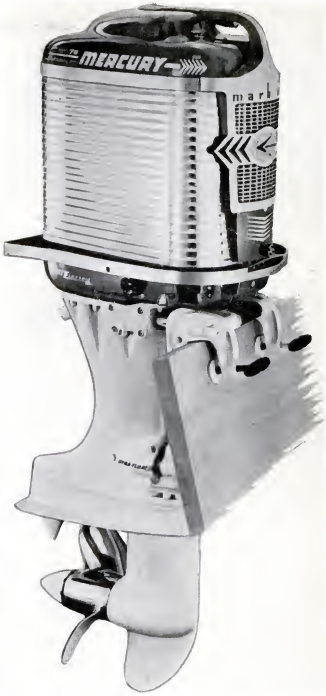
Evinrude has also improved its 35-hp. Big Twins and its 18-, 10-, 7.5-, 5.5- and three-hp. models.

for 1958

shown by the leading makers

Scott-Atwater is making a 22, biggest novelty in its 1958 line and first of the outboards in that horsepower category. Unlike other of the firm's engines, it turns to the right. A cant of about a quarter of an inch plus rubber instead of spring mounts above the cavitation plate compensate for prop torque.

Intake passages are slightly tilted and have a small hole at the low point to eliminate fuel puddling at low idling speed. Excess fuel is drained off at idling to prevent sputtering when the throttle is opened. Starting is manual or electric.



Mercury's new six-cylinder Mark 78 is called the most powerful outboard of the new models. Its horsepower has not been announced, but with a 66-cu.-in. displacement it should be at least that of its elder brother, the 60-hp. Mark 75, which will continue in the line. Both have the Kiekhaefer single-lever safety control and full reversing powerheads.

Other new models include a four-cylinder Mark 58, having a displacement of 44 cu. in., and a 22-cu.-in. automatic-transmission Mark 28.

All the Mercury engines are of in-line design, with overlapping torque impulses from the new four- and six-cylinder units smoothing the power flow. The six's firing order is 1, 3, 5, 2, 4, 6.

PHONE-BOOTH EAVESDROPPING without tapping wires is easy with this little gadget, scarcely bigger than a book of matches, that a man can carry around in his watch pocket. It is a transistor pre-amplifier with an induction pickup. It needs only to be held against the wall behind a phone in use and its operator can overhear what both parties on the line are saying.

Secrets of

Little "bugs" have big ears that may be listening in on what you think is a private conversation

By Wesley S. Griswold

SCANDALS involving electronic eavesdropping have been erupting from Pennsylvania to Texas, from Rhode Island to Oregon.

This eerie super-snooping with hidden microphones and recording machines, commonly called "bugging," has been of vast help to the police and the FBI in rounding up criminals. But other eavesdroppers have outrageously violated our right to privacy, investigating state lawmakers have found.

For instance, mikes have been secreted on the premises of certain used-car dealers, so that salesmen may listen to supposedly private talks between hesitating clients. Armed with this pilfered information, the salesmen have then moved boldly to close deals.

What do employees talk about when the boss isn't near? To find out, a number of factory owners and office managers have had microphones secreted in such places as restrooms and in walls beside public phones.

Politicians, labor leaders and competing business firms in many parts of the nation have set sonic snares for one another. Inevitably, they have trespassed in the secret matters of people not at all involved in their rivalry.

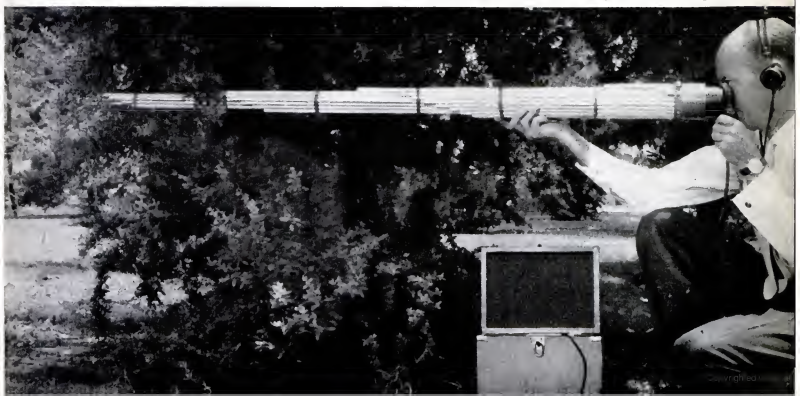
State legislatures are now beginning to crack down on the snoopers. Massachusetts became the first state to outlaw bugging. In July of this year, New York acquired a new law that should put an end to private bugging there, though its police are specifically exempted from most of the restrictions. In California, where the practice is widespread, an aroused legislature last summer passed a law to ban private bugging, but the governor failed to sign it. The legislators thus are balked in their efforts for at least two years.

What weird, wondrous equipment is

the Electronic Snoopers

A TINY, TIRELESS LISTENER to conversations assumed to be private is the American DD4 microphone, wide as a silver dollar and as thick as 10 of them. It is usually connected to a permanent power supply and hidden in ceilings, walls, floors, furniture. Then it can be linked to a recorder.

AIMING A SHOTGUN MIKE at distant talkers enables the operator to overhear their conversation up to a quarter-mile away. On the ground is a battery-powered pre-amplifier to boost sounds for a hidden tape recorder. Operator wears earphones to check quality of the reception.



ELECTRONIC TATTLETALE, devised by Marion Ruggles, has two parts. A transistorized, battery-powered transmitter (above, right) can be clamped to the frame of a suspect's car. Then (left) an airplane direction finder from Navy surplus, plugged into a second car's cigarette lighter, enables pursuers to zero in on the transmitter's continuous signal, blocks away.

used in bugging? What are some of the ways it is put to work?

Outside-the-law operators are naturally shy about identifying themselves or talking. I learned their secrets, however, from two of the nation's leading legitimate professionals, who work in close cooperation with the police. They were willing to tell me all because their techniques had come to public light during hearings before a California State Senate Judiciary Committee.

The first case I heard about was that of the pretty girl in a brief two-piece bathing suit who—though you'd never have guessed it—was wired for sound.

It was a clever job. And in a very few minutes it brought about the undoing of an arrogant young man who was trying to blackmail her. This was a case in which electronic eavesdropping saved an innocent girl's good name and abruptly rid the community of a scoundrel.

The two were fellow students at a California college. Her parents were rich and prominent. He was broke and desperate. He first tried to date her. She brushed him off. Angry and vengeful, he swore he'd accuse her of scandalous behavior, and produce false witnesses to back his claims, unless she gave him $300. She was to bring him the money beside a hotel's outdoor swimming pool at a dependably uncrowded hour of a certain day. She was to be in her bathing suit and carry nothing with her but the cash, concealed in one hand.

After an anguished conference with her roommate, the girl went to the police. She begged them to help her without a hint to her parents or the newspapers. They agreed, and called in an electronics technician. He skillfully hid a tiny radio transmitter and cord antenna in the front of the bra top of the swim suit she was to wear. He cached the power source, a midget battery pack, in the back of it. Then he lugged a radio receiver, a tape recorder and a movie camera with telephoto lens to an eighth-floor room overlooking the pool.

Sight and sound reinforced each other: The rendezvous took place as ordered. Every word that the girl and the would-be blackmailer said was clearly broadcast to the slowly moving tape eight stories above. Meanwhile, the camera recorded the accompanying action.

The young man obtained the money and left. As he stepped into a borrowed car outside the hotel, two detectives closed in on him. They told him how thoroughly he was caught in his act. He handed over the cash, and revealed that

MIDGET BROADCASTING STATION in wide demand for bugging is the Stephens Tru-Sonic microphone-transmitter (above, right). No bigger than a cigarette package, it hides nicely in a breast pocket. At left is a battery pack, small enough to be tucked into a hip pocket, that has power enough for two hours of broadcasting. Necessary wires are easy to hide from view.

BUGGING EXPERTS OFTEN HIDE OUT in cars specially equipped to receive and record broadcasts from planted microphone-transmitters. This is Russ Mason's panel truck, with slot for light, air and scouting. Marion Ruggles has a curtained station wagon with similar equipment.

he had a one-way ticket to Mexico City.

"Use it," the detectives told him, "and don't ever come back here."

He took their advice.

Just what was the gadget? The remarkable transmitter that ruined this particular plot—a true case—is an important bug. It is a Stephens Tru-Sonic wireless microphone, made in Culver City, Calif., and intended for professional entertainers. It is so sensitive that in a quiet place it can overhear whispers 25 feet away, whether or not it is pointed in their direction. The sounds it picks up are broadcast as far as a quarter-mile or, in open country, a half-mile by a diminutive FM transmitter. Stephens builds a high-quality receiver to go with the transmitter.

Mike and transmitter together aren't as big as a package of king-size cigarettes. A battery pack only a trifle larger powers the transmitter for two hours. A somewhat bigger battery pack will keep it broadcasting for 20.

Before long, with the aid of transistors and improved miniature batteries, the whole works is going to be tucked into a single case no bulkier than the present mike-transmitter, the manufacturer says.

When snooping on known or suspected criminals, business rivals, political enemies or errant husbands and wives, the tiny Stephens wireless microphone usually broadcasts to a tape recorder, hidden at a safe distance.

One of my bugging experts, Marion D. Ruggles, an electronics engineer of North Hollywood, Calif., told me that on a summer day he installed one of these extraordinary little transmitting mikes in the hot-air furnace of a small house. Then he and a detective, with receiver and recorder, waited in a station wagon a block away. Soon the people they were expecting returned to the house.

"They moved around, upstairs and down," Ruggles reported, "but no matter where they went, we got *everything* they said. We really had the goods on them."

How are such recordings used? They can become a powerful help in solving crimes, wrecking unlawful plots or persuading battling couples to settle their fights out of court. But they can also turn out to be too hot to handle. The late Serge Rubenstein, notorious New York financial manipulator, is known to have been eavesdropping in this fashion just before he was found murdered.

My second source, another California authority on bugging, Russell D. Mason, also of North Hollywood, told me how he had helped police trap a professional faker of accidents. The crook had been successfully draining insurance companies with false claims until he made the mistake of trying to train an assistant. The eager learner was an undercover man for the cops. Lessons in staging accidents were given in the crook's car, where he thought he was safe from bugs. But the would-be assistant came to school with a Stephens wireless mike in his handkerchief pocket, the antenna sewn into his coat, the battery pack in one of his hip pockets. Mason, with a police witness, recorded the full course of instruction in his own car, parked well out of sight.

Automobiles specially equipped for remote eavesdropping are used by both Ruggles and Mason. Ruggles' is a station wagon with a tape recorder installed in the spare-tire well, under carpeting; an FM receiver; a loudspeaker for monitoring broadcasts from wireless mikes; and a motor generator, powered by 12-volt storage batteries, under the hood. This generator provides 500 watts of 60-cycle AC current to run the electronic apparatus. Ruggles can curtain off the back end of the station wagon and work there in what passersby would assume was an empty car.

Mason's professional vehicle is a panel truck with the same general equipment but with two recorders and two motor generators. He has cut a small rectangular hole in the front of the van to let in light and air and give him a peephole.

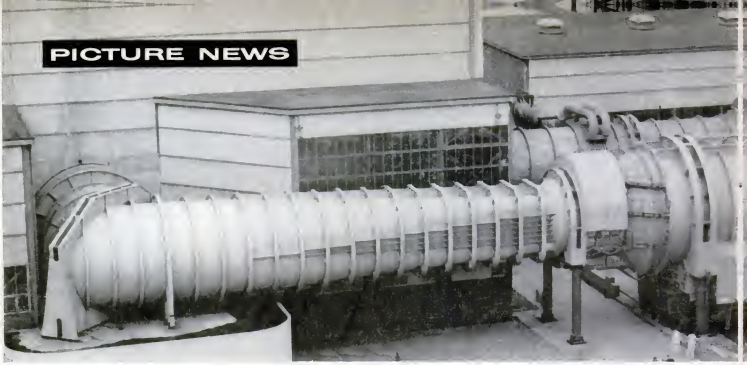
Under the dash of Ruggles' station wagon is hidden a wonderfully effective little microphone that both men have chosen repeatedly for bugging jobs in which it wasn't practical to use the microphone-transmitter. This is the American DD4 mike, which is about the diameter of a silver dollar. It is a low-impedance microphone, which means that wires can be run from it to a recorder for several hundred feet, if necessary, without picking up hum from nearby electrical lines.

Conversation is the target. So, ordinarily, when the little DD4 is used for

[Continued on page 238]

Human guinea pig lives in hood, even while shaving

In a Public Health study of metabolic processes by which food, air and water are utilized, volunteers are living in a sealed chamber at Bethesda, Md. They wear plastic helmets, like that on the man shaving above, with electronic connections to analyze exhalations. Researchers hope to find clues to the cause of obesity, heart disease and cancer.



British wind tunnel blows at three times speed of sound

THIS newest of British wind tunnels—over two stories high and more than a city block long—has been put into service at the Royal Aircraft Establishment at Bedford, England. It was built at a cost of some

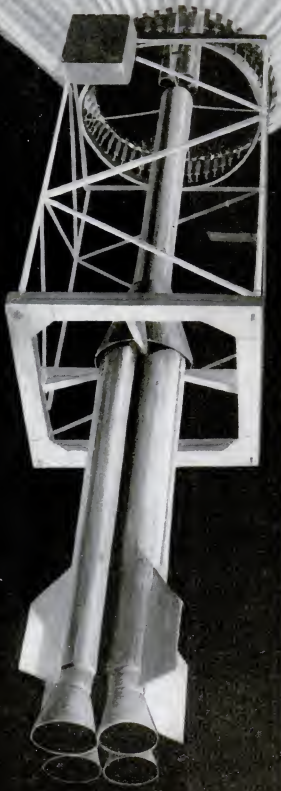
"Cross-eyed" headlights may help drivers see in fog

NARROW-BEAM fog lamps, crossing so the one on the car's right picks up center markers and the other the pavement edge, improve vision in the upper photo of model cars below. Other aids: narrow overhead lighting and bigger tail lights. At bottom is a conventional setup and at right a fog-filled box used at the University of Michigan for the tests.

$30,000,000 and will be used to flight-test airfoils and other airframe parts at subsonic, transonic and supersonic speeds. Experimental models of jet planes that are still on the drawing boards will be tried out in the tunnel at speeds up to three times that of sound.

Navy pilots get flying cues from circular pool table

CONVINCED that pool players make good pilots, a Navy medical officer and a mathematics professor built a round table to make them still better. Capt. James A. Niforopulos (taking shot) and Prof. Robert D. Perry reasoned it would help in working out factors of speed, inertia and angles of incidence for flying curved as well as straight paths.

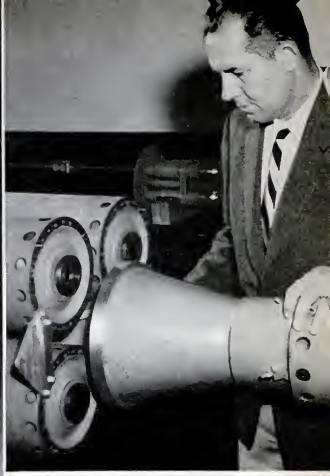


Balloon-launched rocket is built to rise 4,000 miles

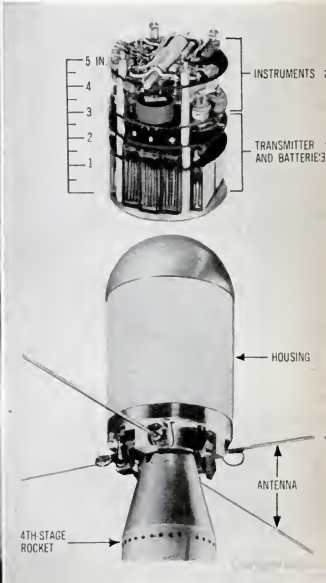
SOARING to record heights, this Project Far Side rocket is expected to collect cosmic-ray and magnetic data 4,000 miles above the earth. A radio in the nose will send results back from space.

The four-stage, solid-propellant rocket will be carried by balloon, as shown here, through the earth's atmosphere to a height of nearly 20 miles. There the first stage, a cluster of four Recruit rockets, will rush it up through the helium-filled bag, dropping off after burn-out, as at right. The second stage is a single Recruit, the third four Arrow II rockets, and the fourth a single Arrow II. Top speed in the 26-second powered flight will be over 17,000 m.p.h.

Far Side, an Air Force project, is directed by Aeronutronic Systems, a Ford subsidiary. General Mills, maker of the balloon, sent a prototype up 104,000 feet in June.



LEADING END of the four first-stage Recruit rockets and tail of the second-stage Recruit being examined by Herbert L. Karsch, project director. Below, the instruments and power pack along with their housing. They weigh 3.5 pounds.

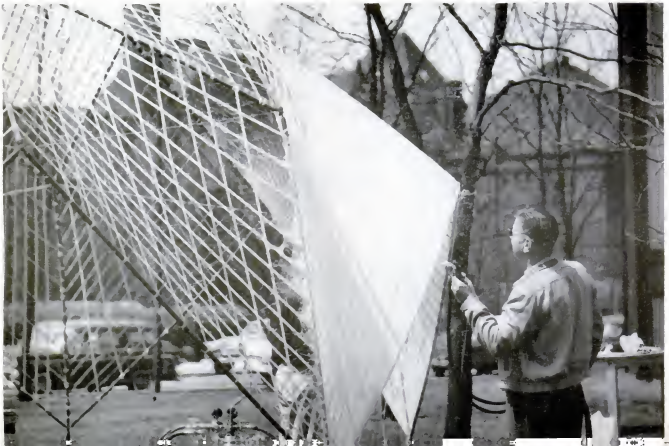


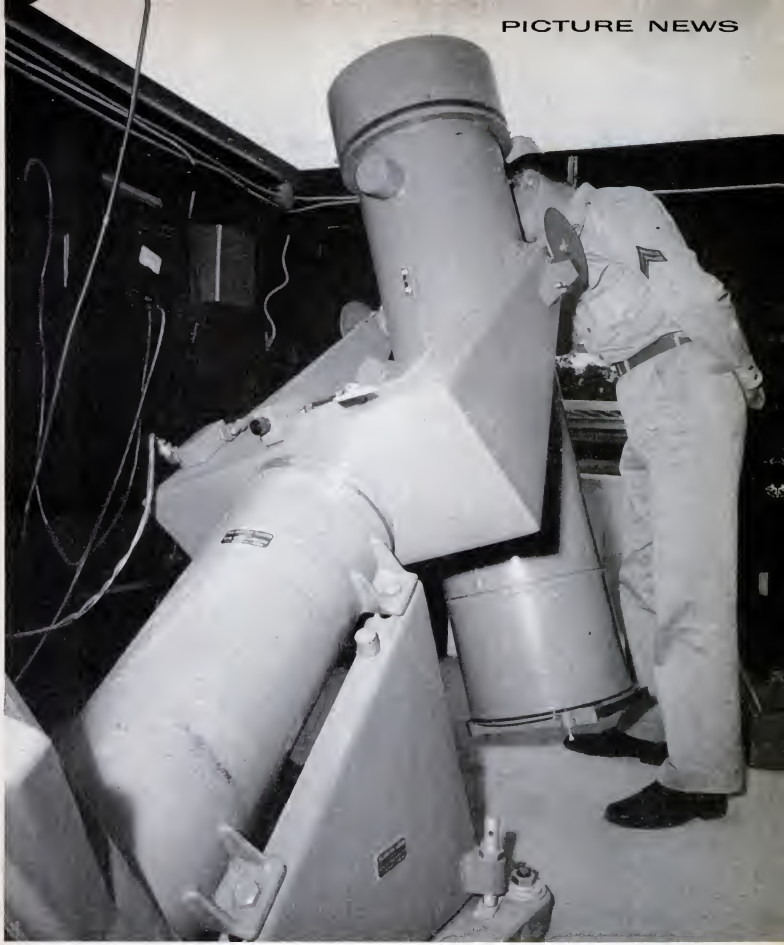
Armored kit protects Army 'dozer in field operations

REMOVABLE armor plate that can be installed by a maintenance crew has been developed to guard the operator and engine of the Army's standard tractors against small-arms fire and shell fragments. It may enable the vehicles to do some of the big tank bulldozers' work—at a fifth the cost.

Experimental cocoon house wears plastic coating

USING techniques employed by the Navy to mothball ships after World War II, two Illinois Institute of Technology students below spray plastic on a steel-tube and cloth-tape frame. They built a 20-foot-diameter shelter in 15 hours in a project aimed at better and cheaper housing.





Camera checks accuracy of satellite-tracking radio

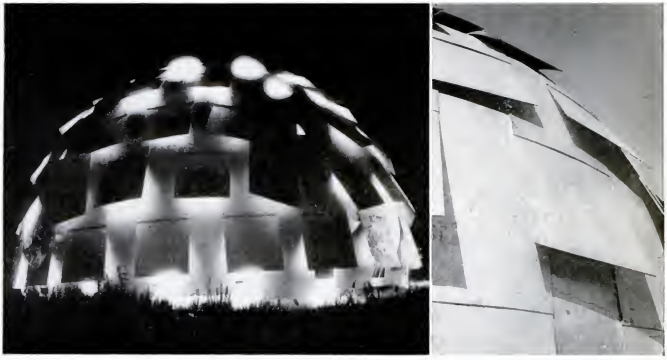
THIS huge camera, mounted like an astronomical telescope at Blossom Point, Md., "calibrates" radio direction finders that will track the projected earth satellite. It photographs a test plane against the stars as a check on the Minitrack station's independent radio observations. If the two methods agree, the radio apparatus is in correct adjustment.

Dummy in new gas mask "sees" with light-bulb eyes

FILTERS in cheek pouches, instead of a hose and canister, make this compact Army mask effective against radioactive particles as well as war gases. Less bulky than the old gas mask, it permits easier breathing and talking. Here it is on a model with electric-light "eyes" that cast patterns on a concave chart to test its wide field of vision.

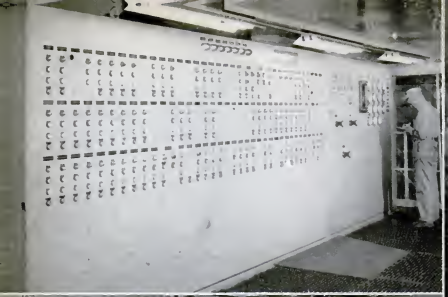
Extra front axle lets concrete truck haul bigger load

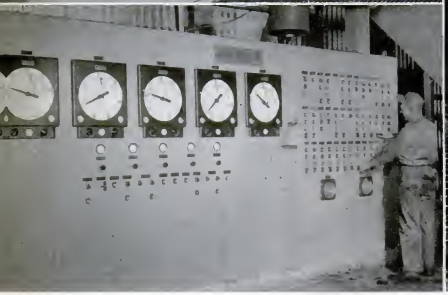
WITH twin axles at the front as well as the rear, this special GMC truck increases payload capacity 30 percent for a Philadelphia concrete-mix company. Controlled from a single steering gear, the four front wheels are all turned in unison by a power-assist mechanism.

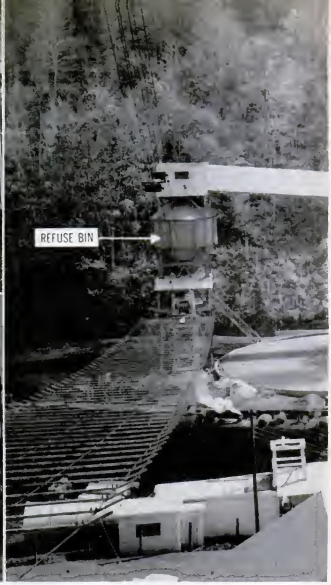


"Pine-cone" dome is made of plywood panels

A HUNDRED four-by-eight sheets of plywood form the 40-foot-diameter, clear-span dome above that lets light and air through at its overlapping edges. Built by Cornell architectural students under the direction of R. Buckminster Fuller, inventor of the geodesic dome, it is proposed as a framework to hold reinforced concrete and serve also as a lining.







Two-man coal plant turns out 450 tons an hour

THIS Clinchfield, Va., coal-mining operation, closed for nearly 30 years, has been reopened with complete automation. Two men at two pushbutton panels control all the processing, from washing coal direct from the mine to screening and loading—handling 450 tons an hour. The

Army's rolling water plant can purify on the run

A PACKAGED water plant, designed at Fort Belvoir, Va., pumps up questionable water, filters it on the run, and provides GI's in the field with fresh drinking water. Army engineers have also developed a larger plant, housed in a knockdown building, for semi-permanent installation.

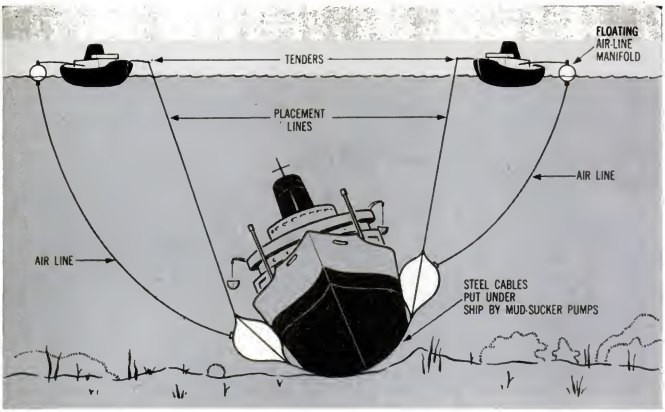
PREPARATION PLANT

CAR LOADING

operator at the upper left controls conveyor belts, apron feeding, wet cleaning, screening equipment and loading chutes; the other dries the coal in hot-air streams by pushing buttons on the panel below. The old mine was found recently to contain much-wanted metallurgical coal. Link-Belt Co. designed the machinery to make reopening profitable.

Glass coin box keeps visual tab on long-distance call

FEED as many coins as you like into this long-distance dial phone, and it takes them one after the other as the minutes tick off. Any left over when the talk ends pop into a coin-return box. It's a German idea for booths, avoids disconnection or request for another 10 pfennigs.



Water wings may lift sunken ships out of sea graves

BIG air-filled envelopes of steel-cord-reinforced rubber may soon be lifting sunken ships from the ocean floor. In a method devised by U. S. Rubber Co. engineers, skin divers would attach the 25-by-100-foot envelopes to the hull, and compressed air would be pumped in from tenders.

Airborne canoes help lake-country pilots get to shore

STRAPPED to the fuselage and supported by a float, a canoe is carried by Canadian bush pilots as an aid to reaching dry ground when they have to come down on a lake. The canoe is lowered into the water by a winch in the cabin, and the pilot makes his way to it on the float.

Swimming-pool cafeteria has human aquarium

PLATE glass forms one side of a popular swimming pool at Wattens, a resort town near Innsbruck, Austria. Swimmers in the pool can watch the diners in the public cafeteria, and the diners can follow the aquatic stunts of the inmates of the human aquarium.

Low-loading express truck picks up at ground level

OPERATED by a hydraulic lift, the body of a new delivery truck being tested by the Railway Express Agency in New York can be lowered to the pavement, raised to loading-platform height or stopped anywhere between. It is said by the builders, Thompson Trailer Corp., of Pikesville, Md., to reduce time by 75 percent for street pickups and deliveries.

"Ski lift" crosses Rhine for sights at Cologne fair

WITH fairgrounds built across the Rhine at a site where there was no bridge, the Cologne authorities put up this cable-car system. It handles 50 four-passenger cars at 12-second intervals, and can deliver up to 1,200 persons to the grounds in an hour. The trip takes five minutes.

Swamp buggy mushes through snow, water and mud

LIKE a muskrat in the northern wilds, this little tractor-trailer unit is at home in soft snow, bush, swamps and deep water. With four speeds forward and one reverse, the RAT makes 22 m.p.h. on land, carrying a 600-lb. load and towing another 1,000. It will crawl up a 60-percent slope, float on water. Canadair builds it for the Canadian army.

Building-site TV gives sidewalk supers a close-up

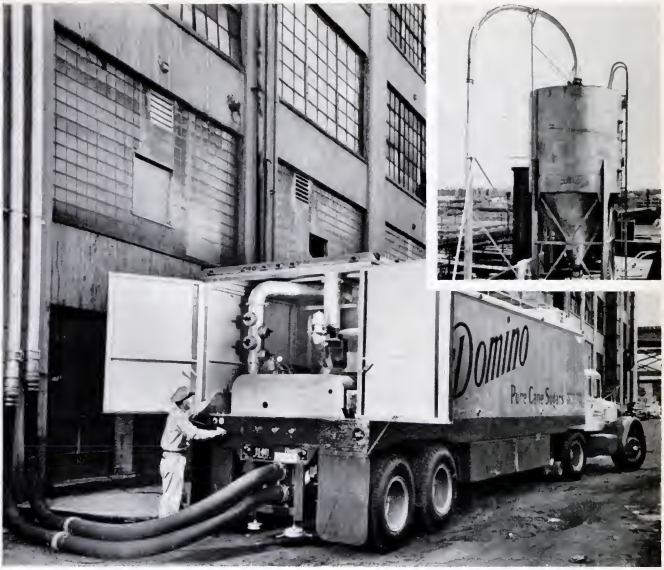
SO NEW YORK'S inveterate "sidewalk superintendents" can see exactly what's going on during construction of a skyscraper, Sam Minskoff & Sons, builders, have installed closed-circuit TV. The camera (left) puts close-ups on three screens. Bulletin boards describe the operation.

Big trailer will haul oil-pumping stations over desert

THIS 80-foot trailer, designed with a low bed to facilitate loading and unloading of heavy turbines and pumping equipment, will help in the installation of booster stations on pipe lines in the Arabian desert. It was built in New Mexico. A 300-hp. diesel tractor will pull it.

Rolling bridge spreads its "wings" for tank traffic

HERE is the British Army's newest way of preventing traffic snarls on shell-pocked battlefields. The Royal Engineers constructed a bridge on the top of a special armored vehicle that they call the Linked Ark. At a



Pneumatic blower shoots sugar to rooftop bin

A NEW truck put into operation by American Sugar Refining Co. has a built-in air pump that blows sugar to customers at the rate of 20 tons an hour. Here it loads a storage bin (inset) atop the Louis Sherry plant in New York through pneumatic tubes on the side of the building.

demonstration below at the Royal Engineers School, the tracked carrier does its stuff. It rolls into a ditch (left) with the bridge folded on top, and at center puts its unfolding mechanism in operation. Moments later, at right, a British Centurion tank rumbles across.

Swept-forward intakes smooth flight as they gulp air

CALLED a tactical striking weapon unmatched on either side of the Iron Curtain, the Republic F-105 Thunderchief scoops air into its single J-75 turbojet through swept-forward wing-root intakes that shatter shock waves as it moves into supersonic speeds. A third air intake in the base of the fighter-bomber's vertical fin cools its hot tail area. It carries heavy conventional and nuclear weapons internally or on removable wing pylons shown (inset) with the plane climbing.

The Case for the Two-Story House

With many strong points in its favor, this "old-fashioned" dwelling is making a comeback

By John L. Springer

IN BUYING or building a home, keep in mind the time-tested advantages of the design that offers the most for your money—the two-story house.

Housing fads come and go, but the two-story job continues to be built. Experts say that a still higher percentage will be built in the future.

Their reason? Modern Americans want space. You get more living space per dollar in a two-story house than in any other design. It's cheaper to build, per square foot of usable floor space, than any other style. Excavating costs, foundation, ceiling insulation and roof are about half what they would be for a one-story house with the same space.

Builders prove their point by drawing a rectangle five inches long and three

To provide the same square footage of living area, a ranch house needs a foundation twice as big as that of a two-story house. Roof area is much bigger, too

"A two-story house is cheaper to build, per

On a lot where the ground slopes sharply, a two-story design is a ready answer to the home-builder's problem

inches wide. Each inch represents 10 feet, and the rectangle represents the 50-by-30 foundation needed for a one-story house with 1,500 square feet.

Now cut that rectangle in half so that you have two rectangles, each 2½ by three inches. One of these—25 by 30 feet—is all the foundation you need for a two-story house that will give the same 1,500 square feet of living space. And the roof area is reduced correspondingly.

Plumbing and heating lines also cost less. Because there are two or more floors to work with, it's easy to run as many as three full bathrooms plus the kitchen into the same plumbing stack—a feat practically unheard of with a one-story house.

Other reasons why the two-story house is worth considering:

- You can build on a small plot. All over the country, land costs are zooming. "Improved lots represent 20 to 25 percent of the sale price of today's new home," says Realtor Lewis W. Gibbs of the Home Finding Service of Rochester, N. Y. "But the required plot of land can be considerably less for a two-story house than for the ranch, and this is a major factor."
- You can build on a problem lot. In many popular suburbs, those are the only lots left—often it's on a steep hillside. The solution is a house that shows two stories on the low grade, one level on the high side. Prefab house manufacturers mass-produce two-story homes for such places.
- You'll sleep more soundly. Architect Herman York of Jamaica, N. Y., designer for huge Long Island developers, says that if you've ever slept in a ground-floor bedroom, you'll appreciate why some people like bedrooms one flight up: Auto headlights won't flash across the windows all night.

Some parents think that first-floor bedrooms make things too inviting for a prospective kidnaper or burglar. They feel more secure when their youngsters sleep eight or 10 feet above ground level.

- Bedrooms will be better ventilated. Even in a low-priced two-story house, it's possible to provide four bedrooms with double exposure—windows on two different walls that capture light and breezes from both directions.

That's because every bedroom can be a corner bedroom. In a one-story design, there are only four corners for the entire house, as against eight (four on each

With four corners available upstairs, all bedrooms can have double exposure

floor) for the two-story house. Try to put four bedrooms with double exposures in a one-story house and you'll have to add corners—which means costly additional foundation and wall space. Result: Many one-story homes have only one bedroom with double exposure. Occupants of other rooms may swelter in the summer for want of a breeze.

- It makes "zoned living" easier. "Homes today have many more noise-makers," says York. "Surveys show that

square foot of usable space, than any other style"

the average TV set is on six hours a day. Radio sets, phonographs, hi-fi and household equipment—washing machines, garbage grinders—all add to the noise. As a result, many adults think that they need a quiet place to preserve their sanity."

Stairs make a good boundary between noisy and quiet areas. In a two-level house, it's possible to create a recreation room with an acoustical ceiling on the lower level. Youngsters can whoop it up without disturbing anyone upstairs.

• It's easier to keep neat. "In a one-story house, youngsters tend to take all their things from their bedrooms into the living room," says Frances K. Legas, of the Society of Residential Appraisers. "Many women say it's almost impossible to keep the living room tidy so that they won't feel embarrassed if unexpected guests drop in.

"Some who have moved to two-story houses say that the problem is solved automatically. The children keep their things upstairs."

Why split levels? Many experts believe that the desire to gain the advantages of the two-story house explains the popularity of split-level designs. Split-levels have spread over the U. S. since the war. "Many are merely two two-story houses stuck together," says Architect Rudolph A. Matern of Jamaica, L. I., a specialist in small-home designs.

In a typical model, you enter from the street into the living-room level. From here you can go down six steps to a recreation room, or up six steps to a bedroom area. From the bedroom level, you can go up seven steps to a floor over the living room. There are actually four different levels, two atop two others.

Many so-called one-story houses are also two-story houses in disguise. They actually have another story above the main floor, another story below it, or both. For example, the typical ranch house in many sections has an expansion attic. When the average family grows and needs more space, it uses the attic as a second story by adding rooms.

The case against two-stories is also worth noting. Albert P. Wittman, head of Home Planners, Inc., an architectural firm of Detroit, says that many people

A stairway is an effective sound barrier between bedrooms and noise downstairs

accept less space in a one-story house for one big reason: stairs.

A mother with small children could wind up exhausted as a marathon runner every day with sick children upstairs while she tries to work downstairs. For older people, stair climbing ranges from a nuisance to a health hazard.

Kenneth E. Sarles of Racine, Wis., president of the Society of Residential Appraisers, has an answer to that objection:

"Modern two-story homes are built to keep stair climbing to a minimum," he says. "They have at least a powder room on the main floor, and also an all-purpose room that can be used as a den, television room, or as an emergency bedroom when the children are ill and need constant attention."

Despite stair climbing, the experts say that Americans will be buying and living in two-story houses for as far ahead as we can see. Two factors—the trend toward bigger families which naturally means more living space, and our constantly rising housing standards—explain why.

"The typical family used to be satisfied with two bedrooms," says Matern. "After the war, they wanted a multi-use room as well. The multi-use room then became a third bedroom. Of course, with three bedrooms they needed a family room. For convenience, they need a half-bath near that room. Where they once had two rooms, they now have four—and 2½ baths instead of one."

Few people can afford such space on one floor. It looks as though the case for the two-story house will be even stronger in the future. END

Gus Turns a Knock

James Selden (nobody called him Jim) was a shrewd man with a

By Martin Bunn

"JUST opening up shop for the day, Mr. Wilson?"

Gus swung around, the key to the Model Garage in his hand. It was young Tommy Brown, who worked nights at the creamery garage.

"Hello, Tommy," Gus said. "Aren't you up pretty early for a Saturday?"

"Couldn't sleep when I got through work," Tommy said. "Too worried about Mr. Selden's car."

Gus shook his head. "Shouldn't take your worries to bed, Tommy. Come in and tell me about it."

Tommy followed Gus into the office.

"You know how Mr. Selden talks about economy and efficiency all the time," Tommy began. "Since he came we've had to do things differently."

Gus nodded. Only last night George

into a Boost

buck . . . which didn't stop Gus from giving him a lesson in economy

Macabee, the salesman, had come to the Model Garage for antifreeze.

"When Selden came last spring," George had said, "he ordered all the old antifreeze drained out of our trucks and saved. Now he's ordered it put back. But this is my own car, and if the firm won't pay for fresh stuff, I will."

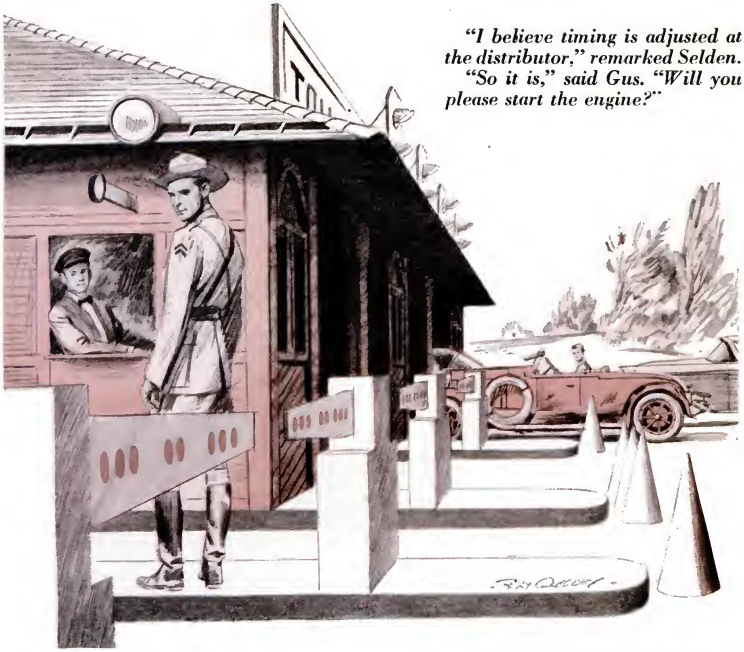
Gus had drained the system, flushed it with the thermostat removed, checked the hoses, pump and fan belt before putting in new permanent-type antifreeze—and wondered what kind of man would risk a fleet of vehicles to save so little money.

"I can picture Mr. Selden," Gus said. "But what's this got to do with you?"

The young fellow squirmed. "He brought his own car in last night. Told me to check the timing because it knocked. The timing was just right."

"And did it knock?"

"I don't know," Tommy said. "Mr.



"I believe timing is adjusted at the distributor," remarked Selden. "So it is," said Gus. "Will you please start the engine?"

Selden said I was not to road-test the car—guess he thinks anybody my age would wreck it. He told me not to do any other work on it."

"What else would you have done?"

"Cleaned the plugs, anyway. Flushed the radiator—the water was pretty dirty."

"You did all you could, Tom," Gus said. "Forget it and enjoy your weekend."

"How can I, Mr. Wilson? Mr. Selden is driving to the city this morning on the new throughway—to go to a big corporation meeting, he said. What if he doesn't get there and it's my fault?"

The telephone shrilled. Gus lifted the receiver. Soon he put it back soberly.

"That was Mr. Selden," he said. "He was stopped at the toll gates 15 miles from here for impeding traffic. He's asked me to come. Here comes Stan now, so I'm free to leave. Got your car, Tommy?"

White-faced, the boy nodded.

"Get in it and follow me," Gus said. "I'll take the wrecker. If Mr. Selden has to make that meeting, it may have to be in your jalopy."

It was the kind of blue-and-gold fall day Gus enjoyed most. The new dual road let his sturdy wrecker kick up its heels. He soon left Tommy behind.

THE slight, thin-lipped man arguing with Trooper Jerry Corcoran at the parking strip across from the toll gate had to be James Selden—Gus would have laid odds nobody called him Jim. Crossing the throughway, Gus parked and walked over.

"You're Wilson?" Selden asked at once. "This officer ordered me off the road. I have an urgent appointment in the city. Please see to my car."

"What's it done?" asked Gus.

"Knocked so badly the last five miles I didn't dare go over 40 for fear it would break down altogether. My fault for letting an incompetent kid monkey with the timing. He advanced it too much."

"But it only started to knock after you had driven awhile at high speed?" Gus asked thoughtfully.

"Yes. I noticed a slight ping earlier, but finally it got so bad I knew I couldn't risk keeping on at 60. Just set the timing back so that I can go fast enough to satisfy this man." He jerked a thumb at Jerry, who reddened.

"I'll have a look at the car," said Gus. As they walked toward it, he spotted Tom's battered roadster pulling up to the toll gate.

RAISING the hood of Selden's car, a popular six-cylinder model about three years old, Gus took off the radiator cap and ran a finger around inside. It scooped up thin brown scum.

"I believe timing is adjusted at the distributor," remarked Selden.

"So it is," said Gus. "Will you please start the engine?"

Selden did. A thin stream of bubbles rose from the brownish fluid in the radiator. Gus peered at the water pump. On the suction side, the block was slightly moist, but no water was leaking out now. He replaced the radiator cap and listened to the engine.

It was rough on one or two cylinders, with a faint metallic knock. Gus signaled Selden to cut the ignition.

Gus closed the hood and came around to the driver's side of the car.

"Sorry, Mr. Selden. It's not bad timing that stopped you, but overheating."

Selden glared at him. "Rubbish. I watch my gauges. The temperature was only a bit higher than usual."

"The gauge tells how hot your coolant is," Gus pointed out. "Not how hot the engine is. Yours is overheating locally. After looking into your radiator I can guess why. The car can't be fixed here, and if you keep running, you may break an exhaust valve or even crack a piston."

"I must get to the city somehow."

"You're in luck, Mr. Selden," said Gus, pretending to look past the wrecker. "A young fellow I know just stopped behind my truck. It's Tommy Brown. He'll give you a lift, while I tow your car back."

Selden's thin lips drew even tighter. "Brown works in our shop. I'll pay him to get me to town, but it isn't going to change my opinion of his work."

He got out, taking his briefcase.

"Mr. Selden," said Gus. "When is it not efficient to save money?"

The manager looked at him hard. "When it costs you more in the long run."

"If you'll come to my shop Monday morning," said Gus, "I'll prove to you that you saved money unwisely on your car—and that Brown had nothing to do with your breakdown today."

"I'll be there," said Selden crisply.

MONDAY morning Gus had Stan Hicks remove the radiator and cylinder head of Selden's car. Tommy watched glumly.

"How did it go Saturday?" asked Gus.

Tommy shrugged. "Awful. Oh, my old crate ran okay. But how do you think Mr. Selden felt riding in my old clunker?"

Tom fell silent as Selden came in briskly and eyed his car.

"Was it necessary to do this, Mr. Wilson?" he asked, pointing to the engine.

Gus switched on a trouble light. "It was, Mr. Selden, to show you three things. First the exhaust valves of the last two cylinders. Both are warped."

Selden nodded. "So I see. Are you saying these caused the knock I heard?"

"No," Gus said. "This valve damage and the pinging were both caused by hot spots inside the two cylinders."

"Or by faulty timing," Selden insisted.

"The second thing is this," Gus went on, pointing to a spot on the water pump. "Water oozes out here when the engine is off. When it runs, the leak stops—because the pump sucks in air and feeds it into your coolant. That causes foaming and boosts corrosive action in the system."

"But that couldn't burn the valves."

"We'll see," said Gus. "Do you drain your antifreeze and put it back in fall?"

"Why, yes. It still has antifreeze protection, you know."

"Sure," Gus agreed. "But did you know its rust inhibitors wear out in a season? That leaves your cooling system unprotected, wide open for hot water, air and leaking gases to cause rust and corrosion."

Selden was silent for a moment. "I see," he said. "Hereafter I'll add extra inhibitor when I put back the antifreeze."

"I wouldn't," said Gus. "The new inhibitor may not mix well with what's left of the old, or you might use the wrong amount. It would take a lab analysis to be sure—and that would cost more than new antifreeze."

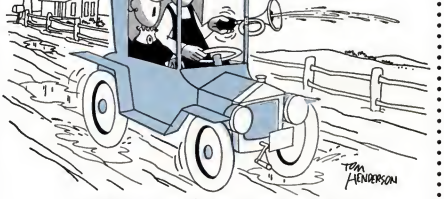
"Maybe so. But you still haven't proved that corrosion is the trouble."

SILENTLY Gus picked up a wrench and took the water pump off the block. Behind it was a water passage. Inserting a wire with a hooked end in this, Gus probed and drew out a long metal tube, roughly oval in section, with slots along the top and ragged holes in the sides.

"Just what is that?" asked Selden.

"Suppose we ask Brown," Gus said.

"That's the water-distribution tube," Tommy said. "It's supposed to carry incoming cool water evenly the whole length of the block. But corroded like that it couldn't, so the last two cylinders got too hot."



"It must've rained awful hard last night."

Gus laid the damaged tube aside. "If you want to take your car to the plant for repairs, Mr. Selden, I'll charge you only for the throughway tow."

"No, Mr. Wilson," Selden said slowly. "I'd like you to finish repairing my car. And put in new permanent antifreeze."

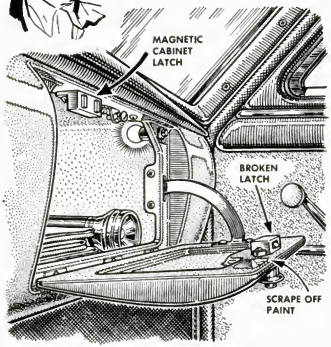
He swung around to Tom. "That goes for all plant vehicles, too, Brown. And you'll find some overtime in your next pay envelope for getting me to town."

"You mean I stay on?" gulped Tommy.

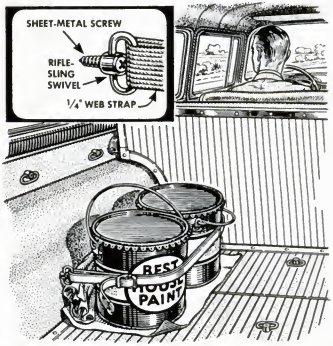
"Of course. As Mr. Wilson promised, he's shown me three things. One, that it isn't always smart to save money. Two, that you know more than I thought." The thin lips smiled for the first time. "And three, that *I* know somewhat less." END

NEXT MONTH: Gus goes out on a limb.

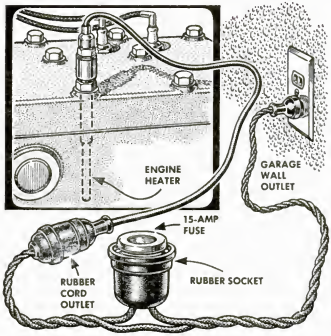
Hints from the Model Garage



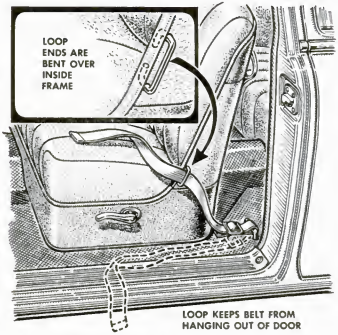
A magnetic cabinet latch can be used to replace a broken glove-compartment lock. Screw the latch to the door frame and scrape paint off the inside of the door where it touches the magnet. The new latch may eliminate some rattles, too.



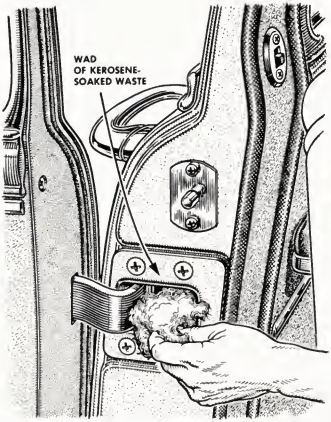
Cargo can be secured in a station wagon by fastening several sets of rifle-sling swivels to the sides and floor of the vehicle with sheet-metal screws. Used with several random lengths of web strap, almost anything can be safely tied down.



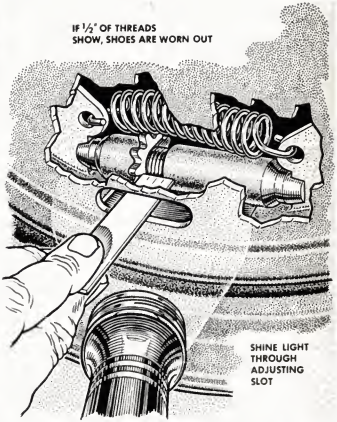
Protect an engine heater by plugging it into a short, fused extension line. Use No. 12 or 14 wire with a plug at one end and a rubber outlet at the other. Cut one leg of the cord and install a rubber socket to hold a 15-amp house fuse.



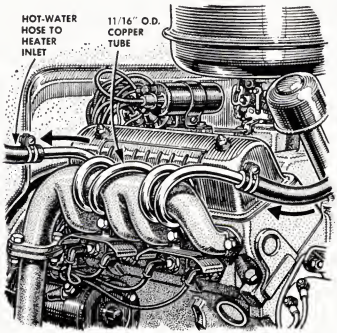
Opened seat belts can be kept from dangling out the door by threading the two outer belts through loops bent from heavy copper wire. Insert the loops in holes punched in the seat frame with an ice pick and bend the ends over.



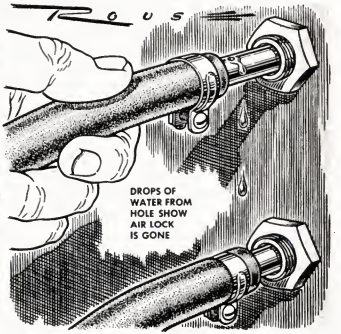
Rusted, squeaky door hinges can be freed and silenced by stuffing a wad of cotton waste in each hinge pocket. Saturate the wad with kerosene or penetrating oil and leave it in place for a few days, or until the hinge responds to the treatment.



Check brake-lining condition quickly on cars with Bendix-type brakes by inserting a ½"-wide strip of cardboard in the adjusting slot. If ½" or more of the adjusting threads is exposed, the lining is worn down near the rivets.



You can get more heat from your car heater by using wasted heat from the exhaust manifold. Wrap a length of copper tubing around the manifold, then cut the inlet hose running *to* the heater and connect the cut ends to the tubing.



To bleed trapped air out of an air-bound car heater, pull back the top hose and drill a ⅛" hole in the fitting. Allow the air to escape until the coolant starts flowing out of the hole. Then push the hose over the hole and tighten the hose clamp.

HOW TO GET: The Fireplace You'd Like to Have

Some decorate, others really warm, some do both—and you'll want to compare the price tags

By David X. Manners

YOU know you want a fireplace. But what kind? Prefab? Masonry? What size is best? Should it have a heat-circulating chassis? How can you be sure it won't smoke? Will it cost a small fortune?

On the following pages you'll find the answers to these questions and others. You will learn the secrets of a foolproof masonry fireplace, the specs on leading prefab and heat-circulating units, the low-down on factory-built chimneys. Whether you plan to buy, build, or have a fireplace built for you, you'll find what you need to know to get the most for your money.

Home and Shop

● ***Prefabs.*** The big bargains today are in factory-built units. Some are really nothing more than stoves with an open front—slicked-up versions of the classic Franklin shin-toaster. You can install one complete for as little as $100. Other prefabs are designed to look almost like the fireplaces you've known all your life. Taking price—$300 to $400.

You can connect a stove-type fireplace as you would an old-fashioned potbelly: by dampered stovepipe to a flue. For a minimum-cost installation in a cabin or one-floor house, you can run its smokepipe right up through the roof. For this, use an insulating sheet-metal roof flange with a galvanized stovepipe for the chimney. Don't ever connect to a gas flue or vent—they're too thin. If possible, avoid hooking up to any other flue that's already being used.

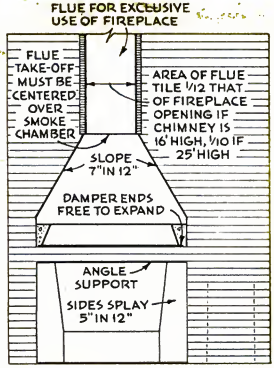
Want a regular chimney? You can build your own with chimney blocks for as little as $25, and paint or stucco it to suit. Or you can install an "Underwriters Approved" prefab chimney for as little as $60 to $80. These lightweight, insulated flues require no masonry and can be supported by the existing wood structure of the house. They can be enclosed in a closet or boxed in with standard framing and wall materials. On the roof, special housings make them look like regular masonry chimneys.

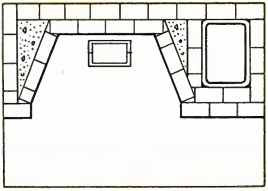
Some prefab fireplaces have insulated bottoms and backs, but most must be kept away from anything that will catch fire. Underwriters recommend a minimum clearance of 30 inches to all woodwork. Advised clearance around stovepipes is 18 inches. These figures, however, may be considerably reduced with special shields.

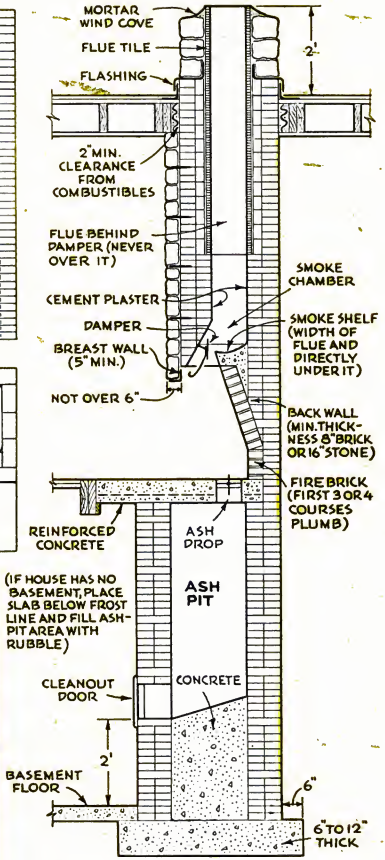
The stove-type prefab fireplace has the advantage of easy installation and low cost. It also gives quicker heat and better radiation than a masonry fireplace.

On the debit side, they're limited in size; few will burn more than a 24-inch log. Also, most types have no anti-downdraft provision, which means more than an average tendency to smoke. Finally, one of this kind just might look like an

Design details for a foolproof fireplace







Related dimensions for trouble-free fireplaces

All dimensions in inches

FLUE SIZE	OPENING		SMOKE-CHAMBER HEIGHT	FIRE-CHAMBER BACK WALL	
	Width	Height		Width	Height
8x12	24	24	19	11	29
	26	24	21	13	29
	28	24	21	15	29
12x12	30	28	24	17	33
	32	28	24	19	33
	36	28	27	23	33
12x16	40	28	29	27	33
16x16	42	30	32	29	35

ACORN

FIREHOOD

KOSMAK

All the details about the new Prefab Fireplaces

MAKE	MANUFACTURER	MODEL	APPROX. PRICE, F.O.B.	SHIPPING WEIGHT (lb.)	DIMENSIONS (inches) Width	Depth	Height	Size Logs
ACORN	Acorn Designs, Inc., Concord, Mass.	Vacation	$69.50	75	27	23½	26½	18
		Deluxe	$99.50	60	24	16	31¼	18
FIREHOOD	Condon-King Co., 1247 Ranier Ave., Seattle 44	30"	$99.50 to $205.50	100	30½	21½	35½	24
		38"		130	37½	28	43¾	30
		45"		160	45	34	51	36
KOSMAK	Kosmak Fireplaces, 45 Castle Street, San Francisco 11	B-18	$135	75	18	20	26	12
		B-24	$150	125	24	22	30	18
		B-30	$165	175	30	24	32	24
		W	$150	125	26	26	34	18
		A	$150	175	35	24	36	24
		S-30-3	$200	150	30	30	34	24
		S-30-1	$210	150	30	30	38	24
		C-24-B	$300	200	24	24	88	12
MANCHESTER-PIERCE	Manchester-Pierce, 1747 Union St., San Francisco 23	MP 105-106	$136	100	24	16	20	18
		MP 101-102	$250	250	34	21	27	24
		MP 103-104	$250	250	34	21	27	24
THULMAN	Majestic Co., Huntington, Ind.	only one model	$275	depends on chimney height	30	24	22	27
UNI-BUILT	Vega Industries Inc., Syracuse 5, N. Y.	only one model	$400 (installed)	depends on chimney height	38½	24½	17½	27

MANCHESTER-PIERCE

THULMAN

UNI-BUILT

CONSTRUCTION	COLORS OR FINISH	FLUE	SUPPORT	EXTRAS	COMMENTS
16- and 12-ga. steel	black	7" rear opening	legs	shielding kit $7.50 coal grate $7.50	Includes fire screen, andirons, damper
16-ga. steel, porcelainized	red, green, gray, black	6" rear opening	legs or wall mounted	shielding kit $9.65 coal grate $7.60 set of legs $2.75	
18- and 12-ga. steel	russet, red, black, white	7" 9" 11"	pedestal, legs, casters or masonry	log grate, screen, barbecue grate	Special colors, copper and custom hoods also available
14- and 11-ga. steel	black; brass, copper, stainless steel, or colored trim extra	6" 8" 8"	legs or wall mounted	packing charge $3	Bottom and back insulated with glass fiber; fire screens and andirons included
18-ga. steel	black	8" turns back or up	legs		
16-ga. steel	black	8"	legs		
16-ga. steel	black black	8" 8"	pedestal	packing charge $5	
18-ga. steel	black	8"	pedestal	packing charge $5	Entire fireplace revolves, so opening can be turned to any direction
10-ga. steel; single wall	black	6" top or rear	4" channel-iron legs or wall mounted	gas inlet built into rear wall of any model $12	Has integral throat, smoke chamber and other features of a heat-circulating fireplace; insulated core models designed for recessing; all models include fire screen and removable grate
10-ga. steel; double wall; hollow core		8" top or rear	5" channel-iron legs		
10-ga. steel; double wall; insulated core		8" top or rear			
aluminized steel; ceramic floor; cast-iron lining, sides and back	surrounds of red brick, black glass available	special 8": chimney top of brick or plain finish	can be set on any type floor or platform	base platform, hearth, screen, grate	Designed to be built in, and to look like conventional fireplace; requires no clearance from combustibles
insulated sheet metal; ceramic-lined fire chamber	may be painted as desired; stainless-steel trim	special flue may be installed with zero clearance from combustibles	wall mounted	grate, fire-tool set	Floor beneath fireplace should be noncombustible, or covered with 3/16" noncombustible material

1 BASE CAN BE FILLED WITH RUBBLE, or left hollow for an ash pit. Brick wall enclosing fireplace must be kept plumb. For a raised hearth, use facing material on the forward edge.

2 CAST-IRON DAMPER should extend the full width of the fireplace. It rests on the fire-chamber top, uncemented. Otherwise, heat-expansion of the metal could crack the masonry.

inexpensive substitute for the real thing.

Prefabs that are designed to look like masonry fireplaces require no clearance and come complete with a prefab chimney. Installation is quick and easy, perhaps no more than four to six hours. Cost is under that of masonry fireplaces of comparable size. Variety is something else again. Sizes and styles are limited.

● ***Heat-circulating fireplaces.*** Place a steel fireplace shell on a prepared hearth, and you need only to surround it with masonry and add a chimney to complete the job. These units have all of the important design elements built in—proper slope of back, splay of sides, size of smoke shelf and proportions of smoke chamber—so there is little chance of construction error.

Their big advantage: They give off more heat than masonry fireplaces. Exactly how much more has never been impartially determined. Manufacturers claim "twice as much." If that isn't enough for your needs, using fans to force air circulation further improves the heat output.

The claim is made that the metal units are just about as durable as masonry. Still, it is advisable to use a fire basket to keep burning fuel from direct contact with the back. Excessive heat may, in

Heat-Circulating Fireplaces

MAKE	MANUFACTURER	ADDRESS	SIZE (inches)	SPECIAL FEATURES
BENEFIRE	Bennett-Ireland, Inc.	Norwich, N. Y. or Melrose Park, Ill.	26x49	Wide variety of decorative grilles
FYRO-PLACE	Syracuse Tank and Mfg. Co.	723 Hiawatha Blvd., West, Syracuse 3, N. Y.	27x60	Expansion channels eliminate joint between masonry facing and fireplace form
HEATFORM	Superior Fireplace Co.	4325 Artesia Ave., Fullerton, Calif.; or 601 N. Point Rd., Baltimore 6	24x71	Units that open on 1, 2, 3, 4 sides; available with hot-water coils; masonry-protected downdraft shelf
HEATILATOR	Heatilator, Inc.	Syracuse 5, N. Y.	28x60	Damper seals airtight
HEATSAVER	Donley Brothers Co.	13902 Miles Ave., Cleveland 5	28x60	Square shape makes it easy to lay up masonry
HOMART	Sears, Roebuck and Co.	Stores, mail-order houses	34x39	Special discount on units shipped from factory
VESTAL	Vestal Mfg. Co.	P. O. Box 152, Sweetwater, Tenn.	30x50	Air-seal damper lock

3 SMOKE SHELF is constructed by building a forward-sloping lip up to damper height, then pouring concrete in behind it to form a ledge. The rear wall should be at least 8" thick.

4 REAR OF SMOKE CHAMBER IS VERTICAL, but front slopes back about 1" per course. After three vertical courses, each side slopes 1½" per course. Interior is mortared smooth.

time, burn through the wall. A chimney cap is also recommended to keep rain from gradually deteriorating the metal smoke shelf.

A circulating unit is likely to cost $40 to $100, or more, over an all-masonry piece. It may be worth it to the amateur builder who'll find that the form makes fireplace building easier and faster. The professional mason, however, is likely to find that installation takes more time than a straight masonry job.

Circulating fireplaces have special use in remodeling existing defective fireplaces. The inside construction of the old fireplace is torn out and the steel unit inserted in the shell and bricked around.

● ***Masonry fireplaces.*** Despite newer units, the all-masonry fireplace still ranks as the number 1 choice. No other fireplace offers so many design variations. It can be open on one, two, three or four sides, set free-standing in the middle of the room, combined with hoods, faced with any wall material, built with barbecue, bake-oven and even smoke-oven facilities, set at the floor, or raised to a higher level.

Most all-masonry fireplaces will cost somewhere between $500 and $1,000. However, with labor accounting for half to 60 percent or more of that, you can save substantially by doing all or part of the work yourself. Materials may cost only $200 to $400. But don't underestimate the sweat and barked knuckles. Figure a minimum of 100 hours of labor when building even a small fireplace.

5 STEEL ANGLE is placed on facing when it reaches a height 5" below the damper flange. The angle acts as a support for a breast wall, and facing is continued above it.

Mistakes in construction? Too many "expert" masons are still guilty of them, though good design is now common building-trade knowledge. So even if you are having someone else build your fireplace, know what must go into one and see that the job is done right. Many factors relating to foundation, clearances, flue sizes and chimney height apply equally to heat-circulating and all-masonry fireplaces. Here are 10 important items to watch:

1. Size. The larger the fireplace, the lower its heating efficiency. Heat comes mostly from heated brickwork, and in a small fireplace it's easier to heat both back and sides. A big fireplace is, of course, capable of supplying more heat than a small one, but it's harder to get

going, uses more fuel, wastes more heat. For best results, keep the fireplace-opening width under 42″, height under 28″, depth under 21″. A depth of 16″ to 18″ is best, although 21″ may look better in a large fireplace.

2. Location. Setting the fireplace chimney outside the house walls saves considerable interior space, but you lose heat and draft. Draft depends on gases reaching the chimney top still hot. This is hard to accomplish in a chilly chimney.

Outside chimneys are more expensive; their walls must be double-thick to protect them against rapid deterioration. If you must have an outside chimney, specify glass-fiber insulation between flue lining and masonry. It will help keep flue gases hot and improve draft.

Preferred room location for a fireplace is an end wall. Cross drafts are less likely there. Avoid locations directly opposite an outside door. Gusty breezes through an open door will force smoke out into the room. Locations near a warm-air register are bad, too. It may create a draft across the fireplace front.

3. Type. You can have a fireplace that's open on from one to four sides, but remember this: The more sides open, the less likely it is to burn well. The traditional fireplace with one long side open has the most reliable operation. A fireplace with one long and one short side open will also give satisfactory service, but you shouldn't have any projecting combustible wall within 5′ of the end opening.

A fireplace with one long and two short sides open is subject to cross currents and downdrafts. For this type, an end wall is almost always a preferred location. Nearby warm-air registers may prove troublesome. If the flow of air from the outlet cannot be deflected, relocate the register or shut it off when the fireplace is in use.

With a fireplace open on two long sides the flickering logs can be seen from two different rooms. But this popular *through* fireplace is also very sensitive to *through* drafts. No matter how well it is designed and built, it may smoke at any slight disturbance of room air—such as an exhaust fan in a nearby kitchen might make. Antidote: Close the kitchen door. Never locate such a fireplace between two outside openings, or else be prepared to close them when you use the fireplace.

A fireplace open on one short and two long sides has even less protection from drafts than a "through" fireplace. A fireplace open on all four sides is recommended only when design and appearance are more important than performance.

4. Foundation. The fireplace base should be a reinforced concrete slab placed below frost line on solid ground, never on loose fill. The slab should extend 6″ to 8″ beyond the limits of the fireplace on all sides and be 6″ to 12″ thick, depending on the type of soil and the size and height of fireplace and chimney to be supported.

A fireplace is likely to be heavier than any other part of the house and to settle at a different rate. Because of this, its slab and foundation should be completely free and independent of the house structure. It should not rest on the basement floor. This slab is too thin to support so heavy a weight.

The fireplace foundation walls may be of masonry block, brick or poured concrete, and the area enclosed by the walls

11 things to do when a fireplace smokes

1. Are you *sure* the damper is fully open? Check it.
2. Lay a fire of dry, seasoned wood against the rear wall of the fireplace. Andirons help circulate air.
3. Make sure enough air can get into the room. Fireplaces use plenty.
4. Close doors and windows that send air currents directly *across* the fireplace opening, instead of into it.
5. Clean soot and debris from flue and smoke shelf, rust off damper.
6. When downdrafts cancel updrafts, build the chimney higher or try a deflecting cap on top.
7. Fill any holes between the chimney bricks to seal off air leaks.
8. Reduce the size of your fireplace

opening if the flue is too small by adding firebrick around the opening at sides and raising the hearth. Or fasten a metal shield across the top of the opening. This also compensates for a damper that was set too low.

9. Brick up all but the main opening of your fireplace, if it has several—unless appearance matters more than performance. Multiple openings raise hob with the draft.

10. Two fireplaces, or a fireplace and a furnace, should not share the same flue. If they do, make sure the unused one is sealed airtight, or they'll share a single draft, too. Here again you invite sluggish flame—and smokiness.

11. Sometimes smoke from one fireplace will come down a second flue in the same chimney and out of a second fireplace, especially if there's a chimney cap. First, remove the cap; if that doesn't help, build one flue up a bit higher than the other.

may be used as an ash dump or filled to hearth level with clean, compacted rubble. Any flue that runs down through the base of the fireplace, such as to a furnace in the cellar, should be enclosed with masonry.

*5. **Hearth.*** A fireproof front hearth is needed to keep sparks and embers from reaching the floor and setting a fire. Its minimum satisfactory width is 16″. Customary construction is of reinforced concrete.

Whether at floor level or raised, the hearth must be entirely supported by the fireplace, never by any part of the floor structure. Usual procedure is to cantilever it. Satisfactory thickness for a concrete hearth is 3½″, with reinforcing rods at foot intervals.

For convenience in clearing out ashes, include an ash pit. If the fireplace is on a slab, or a conventional ash dump is otherwise inconvenient, use a built-in ash collector. This type may be lifted from the fireplace for emptying.

*6. **Fire chamber.*** The walls of the fire chamber must be lined with firebrick. Some varieties of stone explode or disintegrate under heat. Firebrick should be set with tight joints, using special fireclay mortar.

The first three or four courses of firebrick on the rear wall are kept plumb. After that, the rear wall inclines forward. This inclination helps deflect heat into the room and forms a shelf at damper level. This smoke shelf, equal in width to the flue above it, stops downdrafts and turns them up the chimney.

To reflect heat better, the side walls of the fire chamber also widen out toward the front at an angle of 5″ in 12, or a little more than 7″ in a fireplace having a depth of 16″. The walls must fan out equally to ensure an even draft.

*7. **Breast wall.*** To help direct smoke to the damper and keep it from pouring out into the room, a wall must be run across the top of the fireplace opening. This breast wall, supported by a steel angle, must be a minimum of two courses of masonry high and extend from 5″ to 8″ below the damper.

*8. **Damper and smoke shelf.*** Specify dampers made of cast iron or corrosion-resistant steel. They last much longer than those of ordinary sheet steel. In most cases the front flange of a cast-iron damper is strong and wide enough to support the fireplace arch.

Dampers that are closed by poker control are less conspicuous, but rotary controls are easier to operate. If yours is a multi-opening fireplace, be sure to use a damper especially designed for this type. It's larger and higher, and the downdraft shelf and chimney flue can be placed on any side of it.

The damper goes across the narrow opening between the fire chamber below and smoke chamber above. It goes forward of the flue opening, never under the flue or behind it. Its opening must not be shorter than the fireplace opening.

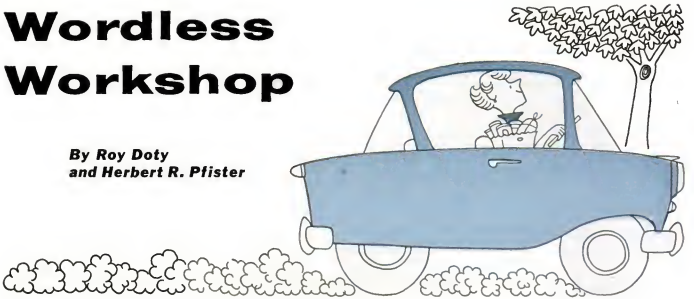
To protect the damper from the intense heat licking upward, its flange should fit flush with the outside faces of the firebrick supporting it.

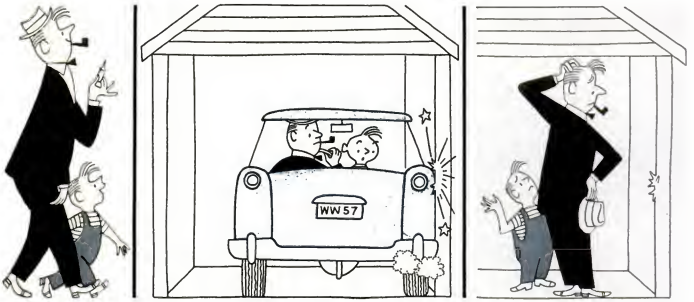
The damper is placed so that its upturned hinged plate forms a baffle along the front of the smoke shelf, stopping downdrafts. The smoke shelf, preferably slightly concave, should be plastered smooth with mortar.

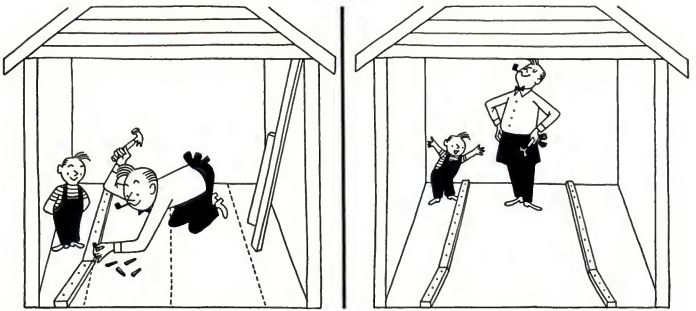
[Continued on page 242]

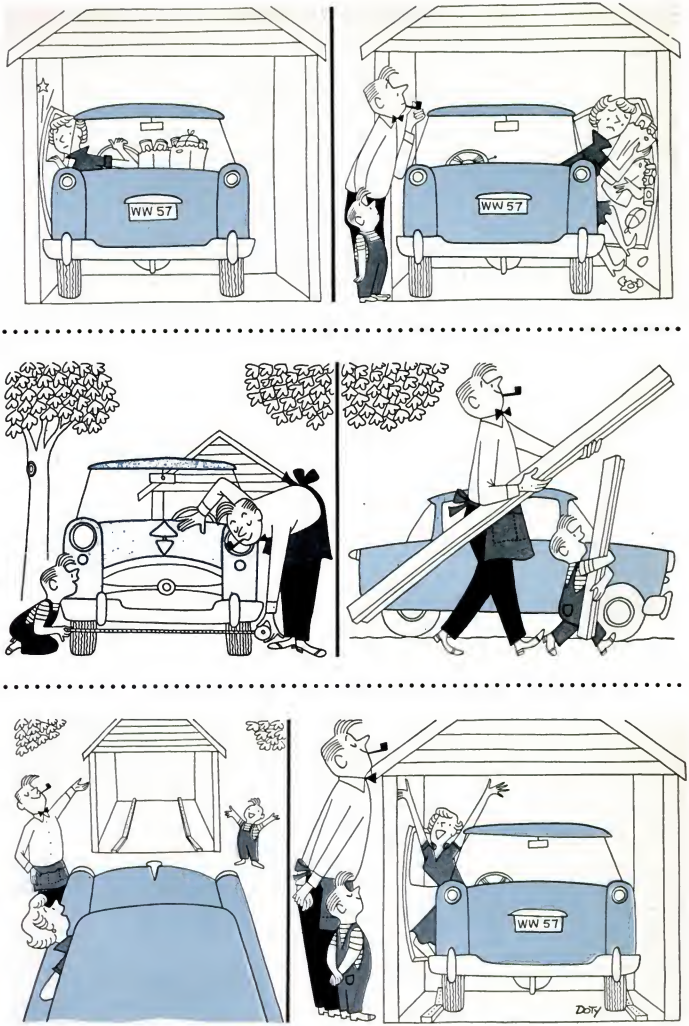
Wordless Workshop

By Roy Doty
and Herbert R. Pfister

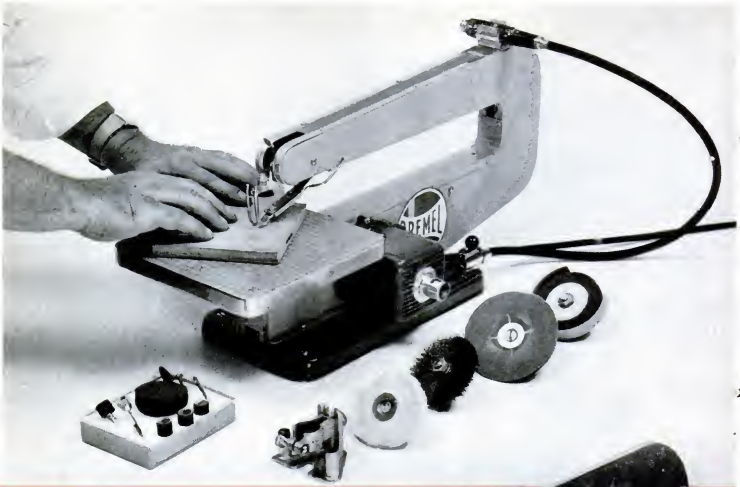


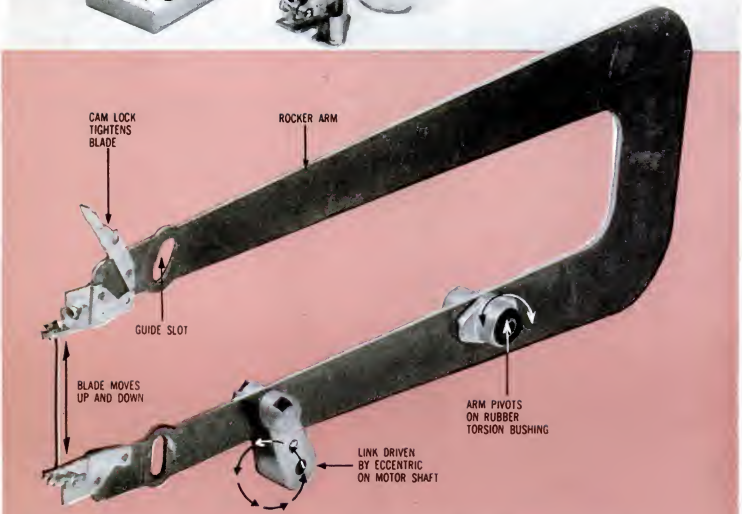






Next Month: A typewriter table that slides under a desk





SAW BLADE is held between ends of rocker arm and kept at uniform tension by cam lock. The arm pivots on a rubber bushing and is moved rapidly up and down by linkage driven by eccentric on motor shaft. Blade cuts wood, plastic and light metal.

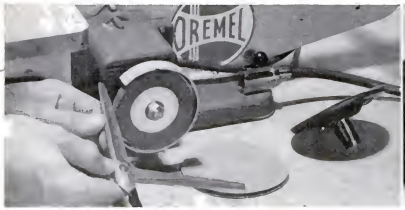
Table-Top Shop Works Wood, Metal

SMALL but capable, this combination tool easily slices its way through metal. The same blade will also cut plastic and wood up to 1¾" thick. Rubber suction-cup feet allow you to set up shop on the kitchen table without marring the surface.

The jigsaw is the basic tool, and a power takeoff on its motor drives a specially designed flexible shaft at 3,450 r.p.m. Accessories include a sanding disk, grinding wheel, wire-brush wheel and buffing wheel. A clamp-on base holds the flexible shaft erect for routing. High-speed cutters, abrasive wheels, drills, a drum sander, bristle brushes and polishing wheels are also available for use with the flexible shaft. The package, made by the Dremel Mfg. Co., 2420 18th St., Racine, Wis., does a variety of shop jobs.

An unusual principle is used to drive the jigsaw blade. Instead of the conventional upper tension spring, which pulls the blade taut against a reciprocating lower blade-chuck, a U-shaped rocker arm holds the blade at uniform tension and rocks it up and down.

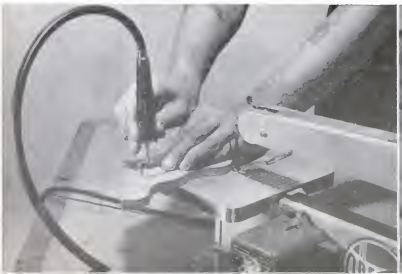
In use, the tool is about as quiet as a sewing machine, which makes it suitable for apartment dwellers. Despite its ability to cut wood or metal with ease, the blade's short stroke and full-length blade guard make it safe for a child to use. The tool weighs 12 pounds. Cost: $33.95 for basic tool and accessories; $49.95 with all accessories shown.



GRINDING WHEEL with guard quickly attaches to the power takeoff on the side of motor and runs at 3,450 r.p.m. Suction-cup feet keep the tool from drifting under side pressure.

DISK SANDER, buffing wheel and wire-brush wheel also mount on the power takeoff. Each wheel is mounted on its own arbor for convenience and to facilitate quick changeover.

DRILLING, carving and fine grinding all can be accomplished with the versatile flexible shaft. Here, the shaft is used to drill the necessary starting holes for inside cuts with the jigsaw.



CLAMP-ON BASE holds the handpiece vertical for routing, rabbeting or for carving in relief. The depth of the cut is controlled by moving the handpiece up or down in the base.

Popular Science designs a new aid to family entertainment:

Wireless TV Phones Let You Listen or Not

Hi-Fi and Electronics

At last you can enjoy TV when you want it—or have quiet in the room while others hear

HERE'S news that every TV owner has been waiting for: a simple way for each member of the family to turn the sound off or on, to suit himself, without annoying anyone else. Now Mom and Pop and Sis and Junior can simultaneously:

- Watch and listen;
- Watch without listening;
- Listen without watching;
- Or, best of all, do something else right in the same room—chat, read, make a phone call, take a nap—without any noisy interference.

The magic that makes take-it-or-leave-it TV possible is a wireless headset, designed by the staff of POPULAR SCIENCE, that permits the TV set's speaker to be silenced. Because the headset is wireless, there's no dangling cord to tether you to the console. You can make the headset yourself in a couple of hours' time. This article will tell you how to build several different types, each one tailored to suit the different members of your family. Or you can order them ready-made.

Peaceful coexistence will pervade an evening at home when you outfit the living room with these remarkable "private ears." You and the missus can now dine graciously, unaccompanied by war whoops and gunfire from the kids' favor-

Found: a new freedom in family TV viewing

NOW DAD CAN WORK IN PEACE without causing the family to pass up their favorite TV show.

BUT HE WON'T MISS A CLUE on that thriller no matter how long Mom stays on the telephone.

PIANO LESSONS CAN GO ON, even when the championship may be decided by the next blow. With the blasting speaker silenced, Mozart and the manly art can share this living room.

THERE'S NO SOUND OF GUNFIRE to interfere with the evening paper or with catalogue shopping.

WHEN MEALTIME COMES in the middle of a program, Tonto can be at the table as a silent guest.

ite thriller. Afterward you watch the fights at ease, never triggering a wifely "turn down the volume." Later you goof off to bed, sans ear plugs, while she emotes in silent solitude over the late tearjerker.

It's like having a separate, soundproof TV room—but with the set left just where it is now. You have the convenience of a speaker going full blast, without its brutal tyranny. If you don't want to watch, you don't have to listen either.

Wireless does it. All previous TV earphone rigs have had three major drawbacks: (1) the trailing cord leashes a user to a fixed radius; (2) conventional earphones feel heavy and uncomfortable after they have been worn awhile; and (3) only a limited number of people could listen.

The problems are licked this way: (1) a clever induction circuit sends a wireless signal to a headset anywhere in the room, eliminating the cord fetter completely. As for (2), the PS headset for adults uses a tiny hearing-aid phone so light as to be unnoticeable; the problem now is to remember to take it off when you go to bed. And (3) there is no limit to the number of headsets that can be used.

Technically, the circuit is as simple to understand as it is to install. You string a couple of concealed wires about the room, and hitch them to the sound output of the TV set. They act as the primary of a giant, room-size transformer. Then you wind a small coil of wire (the secondary) and hitch it to the earphone. Induction does the rest, while blessed silence reigns.

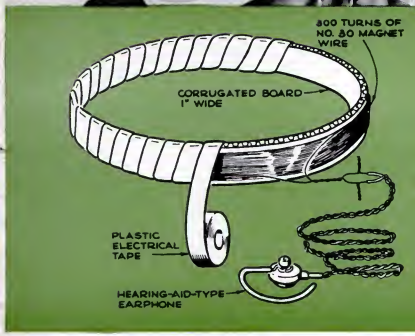
1. *Making the transmitter loop*

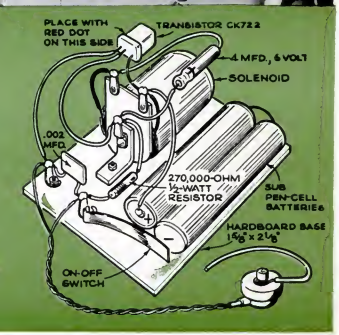
Only one transmitting loop is needed, no matter how many headsets are used. Begin by stringing a couple of turns of wire to encircle the listening area. The wire can be concealed under the rug, tacked around the baseboard or ceiling molding, or even fastened to the joists in the basement underneath. Theoretically, the closer you get the level of the loop to the level of the headsets, the better the system works. Practically, both subfloor and ceiling loops worked fine in the tests made by PS.

THE SPACE HELMET: You just connect a coil of wire to any ordinary headphones and the kids have this nifty-looking wireless headset.

Any kind of insulated wire you happen to have around will serve. If you need to buy some, common No. 18 bell wire is convenient to handle. After running the wire twice around the room, bring up the two ends of the loop near the back of the TV set. Leave a little slack if the set is sometimes swiveled around.

Connecting the loop to the set's innards is simple if you have the least facility in the do-it-yourself arts. And it's safe, if you follow two precautions:





THE GROWNUPS' RECEIVER: You wire a miniature earphone to the lightweight headband coil and have this trim, almost invisible listener.

THE SUPER-DELUXE VERSION: There's no coil to wear with this pocket-size transistor receiver. The diagram shows how to wire the parts.

- Disconnect the power cord before you take the back off the receiver.
- Then sit back and relax for 15 minutes, while the tubes in the set cool off.

Inside the set, your objective is to connect these loop leads to the two wires that previously fed the speaker voice coil. Identify them this way: The wires you want run to the two terminal lugs attached to the speaker frame.

On some sets, these wires emerge directly from the chassis and run to the

PARTS LIST FOR THE TRANSISTOR LISTENER

1 CK722 transistor
1 4-mfd., 6-volt subminiature electrolytic condenser
1 270,000-ohm, ½-watt carbon resistor
1 .002-mfd. ceramic condenser
1 solenoid, 7,000 turns 38 wire, iron core (Gyro Electronics, 325 Canal St., NYC)
2 half-size pen cells, Eveready No. 912
1 plastic box 1⅝" x 2⅛" x 1"
1 earphone, 2,000 ohm (or more), magnetic

speaker. On others they come from an output transformer that is mounted on the speaker frame. If your set is this kind, your pair of wires are the ones that run from transformer to speaker, not the pair from the chassis to the transformer.

For the simplest possible hookup, simply disconnect the speaker and splice the room loop to the leads that previously powered the speaker voice coil. This works fine but isn't ideal, because the speaker no longer plays on the occasions when you want it to, as for intentional collective listening.

The remedy is not really a complication. Pick up something called a "closed-circuit jack" at a radio-parts store. This jack has three connections. Wire them as shown in the drawing. Take the male part, or plug, and connect it to the room loop. The result is magical: Plug into the jack and the speaker is mute but the headsets can receive; pull the plug out and the speaker works in the same old blaring way.

There's one other fielder's choice on the transmitter loop. Sometimes, depending on the TV set and the size of your transmitting loop, something called "impedance mismatch" may occur. (In case you aren't electronically hep, this is *not* the alarming calamity it sounds like—it just means that the sound may not be as clear or loud as you'd like.) The fix is simple here, too. You buy an inexpensive output transformer, snip off the three wire leads to the primary, and use the taps on the secondary as a "matching transformer." Hook it up as in one drawing, and then choose the connections that give you the best sound.

2. Making headsets for the kids

The wireless coil that picks up sound from the big room loop is a completely separate unit. Kids will go for their own special version: It's simply a coil of wire attached to a standard set of earphones. The result is a wonderfully tricky-looking space helmet that will send young imaginations soaring off on trips to the moon—while you remain earth-bound and enjoy the quiet.

The coil and earphones are all there is to the headset. Kids can play, walk about, leave the room and return as they like—all with nothing to hold, carry or trip over.

Winding the coil is nothing more than wrapping wire around anything that's round and of appropriate diameter. The exact size isn't important because the coil doesn't have to fit the head perfectly. Just measure across the headstraps on the earphones and make a coil big enough to go around the outside a few inches above the phones.

Theoretically, the larger the coil and the more turns it has, the better it works. For convenience, a coil about 7″ or 8″ in diameter with from 100 to 300 turns of wire works fine. You don't have to be choosy about the size of wire you use, either. No. 30 enameled magnet wire is readily available, inexpensive, and easy to work with. It makes a coil that is light yet still rigid enough to be self-

To help you build this personal listener

THE editors of POPULAR SCIENCE have made arrangements with Magazine Services, Inc., to manufacture or procure the necessary parts for PS readers. If you cannot locate the correct parts, simply write to:

Magazine Services, Inc.
104 East 26th Street
New York 10, N. Y.

and specify:

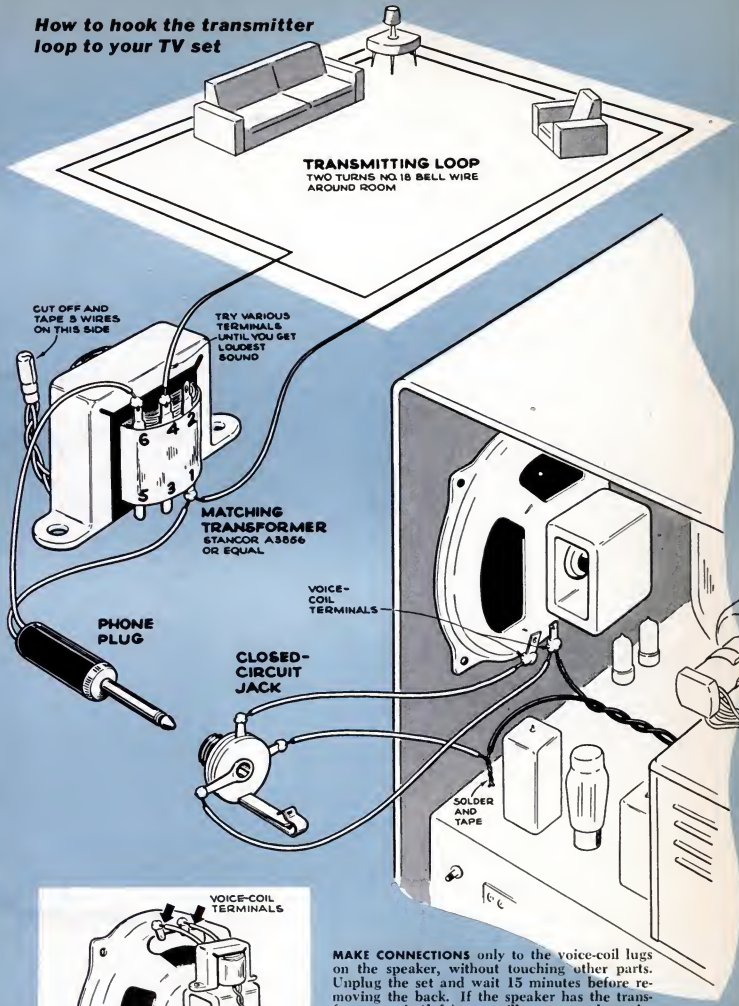
1. What parts you would like to order;

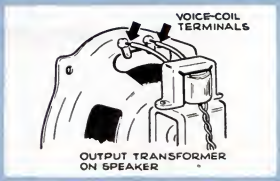
2. If you would like to buy a ready-made head coil (please specify which kind);

3. If you would like to buy a complete unit, including all necessary parts mentioned in the article (please specify which type):

a. Headphone
b. Earphone
c. Transistor

How to hook the transmitter loop to your TV set





MAKE CONNECTIONS only to the voice-coil lugs on the speaker, without touching other parts. Unplug the set and wait 15 minutes before removing the back. If the speaker has the transformer on it (left), you still connect only to the voice-coil terminals (arrows). If you have any doubt as to which ones are the proper terminals, a serviceman can do the job for you.

supporting. The usual collection of kitchen saucepans and food tins should yield a circular form that's just right for winding the coil.

First you tape a strip of cardboard around the form, then start winding the wire on top. The cardboard makes it easy to slide the coil off when it's finished.

Don't worry if keeping an exact count of the number of turns seems troublesome. Just keep winding until you have about 300, then slip the coil off the form and tape it in five or six places around the circle. Bring the two ends of the coil together and scrape off the enamel coating at the ends. To these ends, solder and tape two pairs of short, flexible leads as shown in one of the drawings. These flexible leads connect the coil to the earphones, one pair going to each phone.

Spacemen won't squabble. When the connections have been made, wrap the entire coil with plastic electrical tape. There'll be no wrangling over which headset is whose if you use a different color tape on each coil for quick identification. You can also work out bright, fancy combinations by alternating two colors, such as red and white, yellow and black, and so on.

As you wrap the coil, include the flexible leads under the tape for about half the distance around the circle before they emerge to go to the earphones. Tape the coil itself to the two cross-straps on the headset.

To hook up the earphones, you simply disconnect the regular cord that comes with them and connect the flexible leads to the same terminals. That's all there is to it. Switch on the set and your junior space cadets are ready to receive secret messages from their favorite hero.

3 *Making the grownups' version*

The receivers for adults work in exactly the same way as those for the kids except for one important difference: Instead of the bulky earphones that the youngsters go for, the pickup coil is wired directly to a tiny, featherweight earplug of the type that's used with hearing aids. You scarcely see it, scarcely feel it. Yet you can pick up programs—or ignore them—just by wearing or removing the earplug.

The single earplug gives you plenty of listening privacy, yet doesn't block off both ears. You still have one ear free to carry on a conversation, cover the doorbell or heed the inevitable Daddy-I-want-a-glass-of-water from the bedroom. For safety's sake, you can always hear what's going on in the house.

The remarkable thing about the receiving coil is that, unlike the kids' headset, you can either wear it or not as you wish. It's designed as a headband so that you can put it on whenever you walk about or want to have your hands free. But if you don't feel happy wearing a halo, simply place it beside you on the arm of a chair or a nearby table. The coil works just as well either way.

A built-in volume control is another bonus you get. Just by tipping the coil, either on your head or off, you can reduce or increase the sound level. Reception is loudest when the receiving coil is

[Continued on page 244]

How five receivers compare in PS tests

ALL OF the combinations listed below were tested under similar conditions and are ranked in order of their performance. Only slight difference in quality was found between adjacent listings up through No. 4. No. 5, however, proved considerably less satisfactory than the others.

1. Transistor amplifier—loudest and clearest of all.

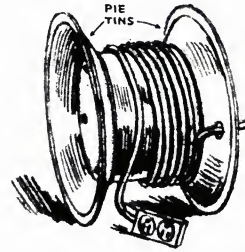
2. 300-turn coil with high-output dynamic miniature earphone (Lafayette No. MS-260)—almost as good as the one above under most conditions.

3. 300-turn coil with surplus HS-30 headphones.

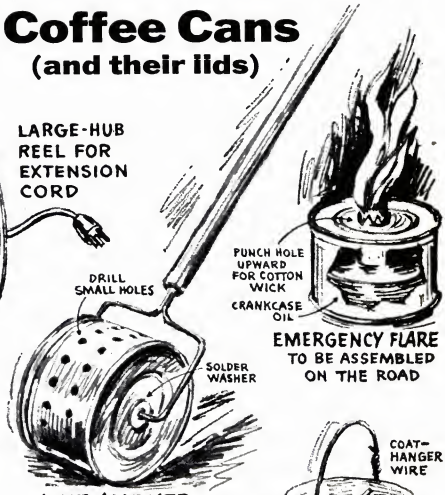
4. 100-turn coil with Trimm "Professional" 70-ohm headphones.

5. 300-turn coil with an ancient pair of 2,000-ohm headphones that date back to crystal-set days.

8 USES FOR Coffee Cans (and their lids)



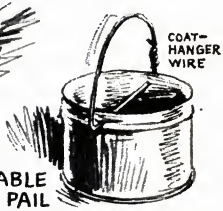
LARGE-HUB REEL FOR EXTENSION CORD



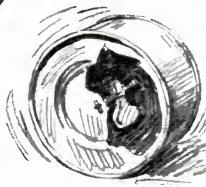
EMERGENCY FLARE TO BE ASSEMBLED ON THE ROAD

LINE MARKER FOR BADMINTON OR TENNIS COURT

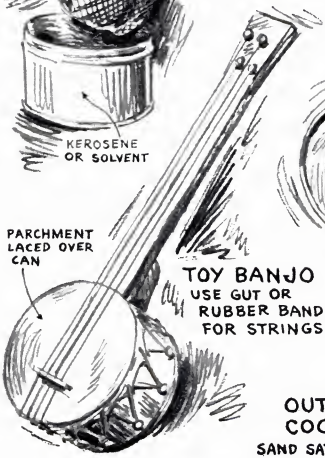
SMALL-PARTS CLEANER SCREEN HOLDS PARTS, LETS SEDIMENT FALL TO BOTTOM OF CAN



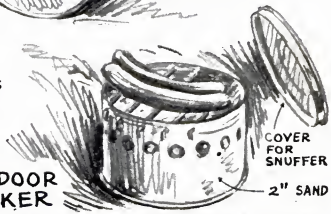
DISPOSABLE PAINT PAIL FIT WITH WIRE HANDLE FOR WIPING BRUSH



ROLL-BACK TOY AS CAN IS ROLLED FORWARD, WEIGHT WINDS UP RUBBER BAND CAUSING CAN TO RETURN

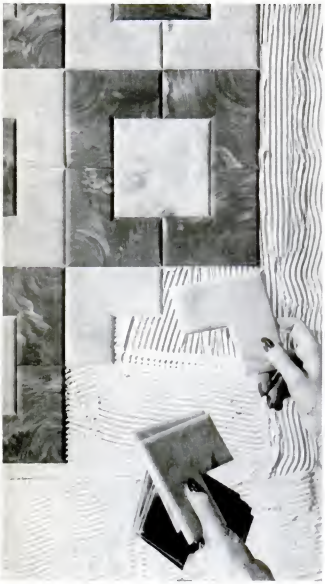


TOY BANJO USE GUT OR RUBBER BANDS FOR STRINGS



OUTDOOR COOKER SAND SATURATED WITH GAS BURNS LONG AND CLEAN

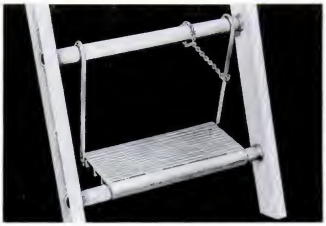
New for the Handyman



1. Oiler Has Pump Tip. A new precision oiler, imported from Switzerland, shoots oil at any angle, making it possible to lubricate normally inaccessible spots—even those overhead. As you press the tip, oil flows out. Release it, and the tip draws excess oil back into the cartridge. You can refill the cartridge with any light machine oil or penetrating lubricant.

2. Design Your Own Wall. L-shaped plastic tiles combined with full-size square tiles, halves, quarters or triangular eighths, make planning a wall an interesting game. With 66 colors to choose from, over 4,000 color combinations are possible. Designs with the various tile shapes are practically unlimited.

Free design kits available from the manufacturer help you plan a wall. You then take your design to a tile dealer who will lay out an actual section so you can see how it will look. You can apply the tiles yourself or have a professional follow your design from the kit.



3. Step Hangs on Ladder Rungs. You can stand on a ladder in comfort when painting or doing work that keeps you on the rungs for long intervals. This aluminum step rest reduces fatigue by providing a platform over the rungs of any straight or extension ladder.

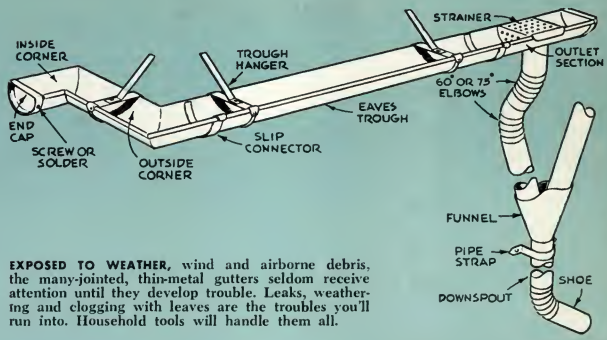
The step hangs from one rung by two brackets and is supported by the rung below. A safety chain prevents it from accidentally falling off.

More information *about these products can be obtained from: 1. Foremost Commodities Corp., 220 Fifth Ave., NYC; 2. Aircrest Plastics Co., Inc., 255 W. 79th St., Chicago; 3. R. D. Werner Co., Inc., 295 Fifth Ave., NYC.*

Do your gutters need cleaning? It's a job you should do each fall. The fact sheet on the facing page will guide you in all aspects of maintenance and repair of gutters and downspouts. It's specially designed to be saved.

Next Month: Full details for installing a new electric-iron cord.

Popular Science Fix-It File



EXPOSED TO WEATHER, wind and airborne debris, the many-jointed, thin-metal gutters seldom receive attention until they develop trouble. Leaks, weathering and clogging with leaves are the troubles you'll run into. Household tools will handle them all.

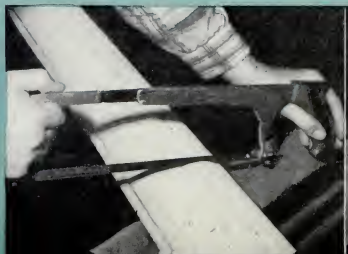
What to do about leaks

APPLY A PATCH: Insert a new section of trough—or thin aluminum sheet—inside the old gutter on a bed of asphalt cement. Crimp new edge over old one to lock patch.

RESOLDER LOOSE JOINTS if they were originally soldered. Wire-brush the area clean, then flow solder into the joint with a torch until the patch is solid and watertight.

CUT AWAY THE BAD SECTION and replace with a new one if rust has eaten through a wide area. Using a hacksaw *backwards* often helps to make cutting easier on thin metal.

JOIN NEW SECTION to existing trough with a solderless slip-on connector, as here. Coat the trough ends with asphalt cement before pressing them into the connector.



What to do about clogging

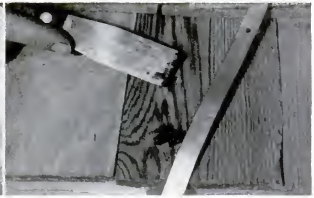
IF DOWNSPOUT IS CLOGGED, run a plumber's snake down inside to penetrate and loosen the clogging mass. If possible, try to pull the mass up rather than force it downward where it might pack hard midway in the pipe.

FROZEN DEBRIS can be thawed by pouring a kettle of hot water mixed with salt into the gutter or down the spout. To add pressure to the flow of water, connect a garden hose to the hot-water faucet at a laundry tub.

CLOGGED ELBOW is best cleaned by removing it, thus eliminating the danger of pushing dirt into the downspout. If joints are soldered, use a torch lightly to open them. After cleaning, flow fresh solder into the joints.

How to prevent stoppages

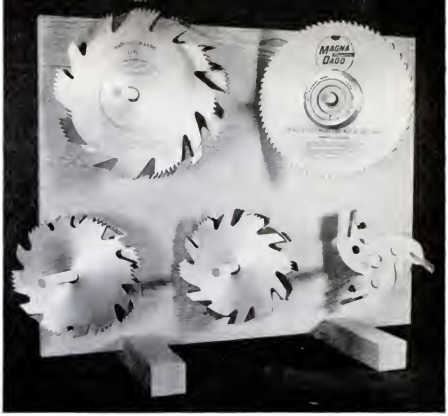
COVER GUTTERS WITH HARDWARE CLOTH: This material can be nailed to the edges of wood gutters or stapled beneath the lowest roof shingles to enclose metal trough. Use an insecticide spray bomb on wasps' nests before attempting to remove or destroy them.



IF TROUGH HAS SAGGED, pull up hanger straps, fill nail holes with cement, then reset straps so that the gutter slopes ½" in 8' toward the downspout. Clean the gutters in spring and fall and flush with a hose, noting any low spots where water stands.

How to paint gutters

WIRE-BRUSH AND PAINT galvanized gutters every three to five years, but don't paint new metal until it has weathered. Scrape off the rust and apply a rust-sealing primer. Paint on a dry day above 40°, but not in the hot sun. Copper and aluminum do not *need* painting, but to prevent stains on white siding, copper should be varnished or painted. Coat the inside of wood gutters with asphaltum paint (center). Tack a paint-roller sleeve to a long stick to solve the problem of painting the inside of downspouts (right).



DADO CUTTERS: At the top left is a high-quality 8" assembly with hollow-ground outside blades. Beside it is a popular wobble blade. At the lower left and center are two assemblies that rely on beveled or set teeth for clearance. The common molding head at lower right can be used for dado cutting if the right width blade is used.

Beginner's Guide to Dado Cutting

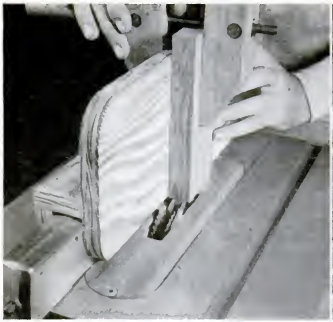
By R. J. De Cristoforo

SET a circular saw blade at a height less than the thickness of the stock you are using; make repeated passes to widen the normal saw kerf and you wind up with a U-shaped cut called a dado—if you're cutting *across* the grain. Do the same thing *with* the grain and the cut you make is properly called a groove (grooving and ploughing are the same thing).

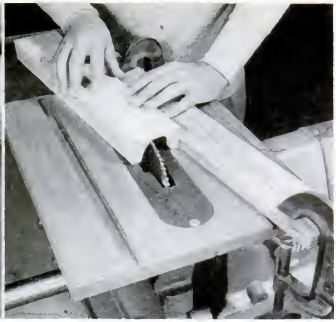
Such U-shaped cuts, either across or with the grain, are often needed in shop projects. It is natural, therefore, that one of the first things the owner of a new table saw decides to buy (after some extra saw blades maybe) is a tool that

STANDARD CUTS that you can make with dado cutters are shown here. Spirals, round and square tenons, surface carving are some of the many possible novelty cuts you can create.

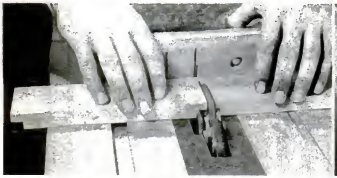
Five jobs you can do with a dado cutter



1 TENONS ARE CUT IN ONE PASS in flat stock by centering a spacer the thickness of tenon between dado blades. Place an outside blade on each side of spacer and add chippers to remove waste stock. Clamp the work to a sliding jig.



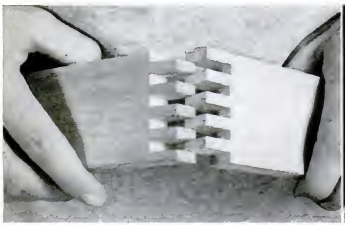
2 COVES ARE MADE by passing stock obliquely across a turning saw blade. A wobble dado (not a dado assembly) set for about a ⅜" cut, will double amount of material removed in pass and cut a relatively flat-bottomed cove.



3 RABBET AND CUTOFF are made in one pass by combining two dado assemblies and a larger-diameter saw blade. The larger center blade cuts through first, so use an extension block on the miter gauge and hold the work firmly.

4 TO FORM SPIRALS, start end of stock against the turning cutters, then turn it counterclockwise. The "lead," determined by the miter-gauge angle, will walk stock across dado. Tapered spirals are made by tilting the blade arbor.

How to cut a finger-lap joint



FINGER-LAP JOINT, used for decorative box corners, can be made almost automatically with dado cutters. You use an extension on the saw's miter gauge to space the cuts accurately. You get fingers that interlock precisely.

GLUE GUIDE BLOCK the thickness of finger in slot cut in extension. Shift extension and fasten it to the miter gauge so that a second slot can be cut a finger thickness away from the block. The fingers should measure from ¼" to ⅜" thick.

5 BLIND SPLINES strengthen a butt joint. Use clamps to establish start and end of groove cut. Hold stock against fence and lower it over turning blade. Advance stock until it touches the second clamp, then shut off the saw.

SET DADO HEIGHT to thickness of stock used and make the first cut by butting one part against the guide block and passing it over the dado. Hold the stock firmly against the miter-gauge extension and flat against the table surface.

PLACE SLOT IN FIRST PIECE over guide block and butt second piece against block. Holding both pieces together, pass over dado. Shift to seat each new slot on guide similarly for automatic spacing of following cuts. [*Please turn page*]

will make the cut quickly, in one pass.

That's what a dado head does. It may be an assembly of twin outside blades and chippers of different thicknesses, a single blade with a hub assembly that tilts it so it moves from side to side while turning, or a common saw blade with special washers that do the same "wobble" job.

The combination of chippers used with the outside blades of a dado assembly determines the width of your cut. With a wobbler, width of cut is controlled by how far out of line you throw the blade.

An exponent of the wobble type may say: "Heck with an assembly! With my wobbler, thickness settings between minimum and maximum are infinitely variable. I can get *exactly* the right width."

"Who needs it!" exclaims the assembly user. "I can assemble mine for all standard stock. If slight variations in thicknesses mean I'm not exactly right, I use paper shims between chippers. And I've got a fixed surface that makes it easy to measure fence settings. Your wobbler moves from side to side and makes it tough."

Well—most times loyalty is 90 percent confidence born of familiarity with the tool. If you know how to use it and it does the job, then it's the tool for you.

Failure to get a flat-bottom groove, even with a brand-new dado assembly, is a common and justifiable complaint. Recent talks with a large manufacturer revealed that the care and precise attention needed to produce dado-assembly components that will cut a perfectly flat bottom are impossible if the unit is to sell in the $10-$15 popular price range. This means that we, the buyers, have established that we'll spend just so much money for the tool. The manufacturer does his best to supply a quality item in the price bracket that will keep his product from gathering dust on the dealer's shelves.

This has no bearing on the quality of the materials used. It affects only those last details of manufacture that would insure that each tooth is exactly the same height, and that the raker teeth are the same height as the chippers.

Luckily, however, we can turn any ordinary dado assembly into a more precise instrument merely by marking, jointing and sharpening *before* we cut with it. This is admittedly a nuisance; no one likes to put this kind of work into a tool he's just socked out good money for. But, if it's done, the increase in cutting quality will really pay off handsomely and your dados will have square corners and flat bottoms.

5 Hints to Users

(to make manufacturers happier)

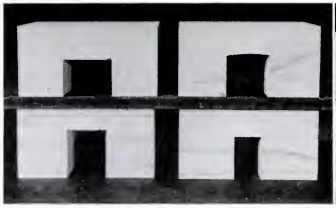
1. Don't run a dull dado—it just won't do a good job. Don't run a dado that's not perfectly round—joint and sharpen it.

2. Assemble chippers and outside blades so that none of the teeth are in line with the others. Teeth lined up like marching soldiers produce a chattery cut. Staggered teeth (see drawing) smooth out the cutting action.

3. Make cuts slowly and smoothly. Don't cut too deep. If excessively deep cuts are required, make them in two or more passes with your saw blade.

4. If you can't do a good jointing and sharpening job yourself, go to a professional.

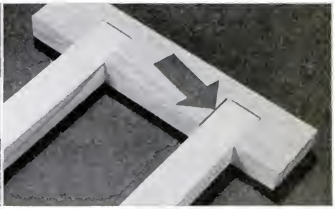
5. Keep your dado parts clean. Check them periodically and, if necessary, clean away gum and dirt deposits with a cloth dipped in turpentine. Store the parts carefully. Don't let cutting edges knock against other surfaces. If storing parts, especially outside blades, for any length of time, protect them with a light film of oil.



DADO CUTS IN CROSS SECTION: Top left is clean cut by molding head. Next to it is arched bottom made by a wobble saw. Cut at bottom left was made by a low-price dado set, the one at lower right by a $53 hollow-ground assembly.

FILE SMALL INDEXING NOTCHES in the arbor holes of outside blades and chippers. Use them to place the assembly parts consistently in same relative position on the arbor for cutting, and for jointing or truing before sharpening.

DADO GAUGE is handy for setting wobble blade. Make a sample cut at each setting, then check it to determine width. Make a new gauge after each blade sharpening; slight change in the blade's diameter affects the width of cut.



SPEED affects wobble blade's cutting width. At left is cut made at 3,400 r.p.m. (table-saw speed). Same setting at 2,200 r.p.m. produced wider cut shown by 1/16" gap (arrow). Use same speed for trial cuts and actual work. END

5 Hints to Manufacturers

(to make dado buyers happier)

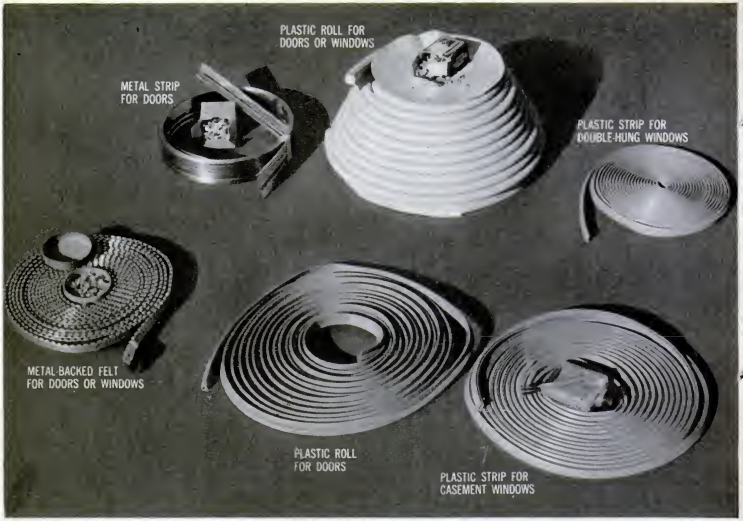
1. Mark arbor holes of the cutters (see photo at top of this page) so users can consistently place them in same relative position on arbors. So placed, the cutters will consistently run true. (This would also apply to regular saw blades.)

2. Supply hollow-ground outside blades. Couldn't you grind just *one* side of each outside blade? Would this make them cheaper to produce and thus make hollow grinding available at a lower price?

3. Supply some die-cut paper shims. We know you can't anticipate variations in wood thickness, but it's a pain in the neck to have to cut our own "adjusters."

4. Supply instructions for jointing and sharpening your product. If we don't do this job ourselves, we can give the instructions to the professional sharpeners, some of whom need them. Either way, some expert tips from you will help us make your product into a more precise cutting instrument.

5. Supply outside blades, whether with set teeth or not, so that when used together they will be just right for ¼" stock. Even a slight set on ⅛"-thick blades spoils them for ¼" dadoes.



A TYPE FOR EVERY JOB: You can buy weather seals by the roll or in handy kits that include all the parts, even the nails.

Now's the Time to Weatherstrip Your House

Before those wintry blasts strike, here's what you should know about the many materials available and how to use them

By Paul Corey

JUST by weatherstripping your house you may be able to cut fuel bills as much as 25 percent. Surprising? Not when you consider that you may have a hole in your wall big enough to throw a basketball through. You can't see it. But the hole's there just the same —stretched out thin in the form of many tiny cracks running around your doors and windows.

By sealing up these heat leaks, you make your house warmer, less drafty and more comfortable. Weatherstripping also helps to keep out dirt and noise.

Modern weatherstripping comes in many types. There's not a great deal of variation in efficiency, but there's a big difference in cost, in how long they last, and in ease of installation. You can weatherstrip a door for 50 cents or $5. You can do a quick tack-up job that may last a year, or you can put in a neat,

concealed installation to last the life of your house.

Types of weatherstripping: There are three basic weather-seal materials—fabric, plastic and metal. The fabric, and most of the plastic types, work as gaskets. You mount them on the face of a frame or molding, and the door or window swings against them, compressing the material to make a tight seal.

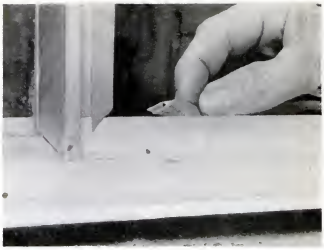
Gasket-type weatherstripping does not stand up well when used against a sliding surface, such as a window that is constantly moved up and down. Because it's surface-mounted, it's also not as neat looking as a concealed installation.

Metal weatherstripping mounts right in the window track or door recess and is almost invisible. It's not worn away by the sliding action of a window and makes a neat, permanent installation.

Two other types of material make good weather seals but in a limited way. One is spun glass which you poke into cracks with a knife. The other is a ¼″ cordlike mastic which you press into cracks with your fingers. These will stop heat leaks, but they can't be used to seal windows and doors that are in use.

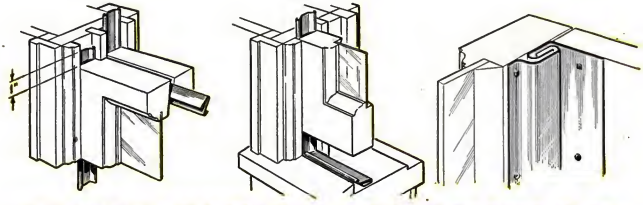
Fabric seals: These work on the gasket principle, cost little, may not last long, and look conspicuous. But if appearance doesn't count and you want to seal a window that is not often touched, any of these will serve for years. The category includes hair felt, wool felt and cotton weatherstripping.

● Hair felt has been around the longest. It is bristly stuff which comes in small rolls, enough to do a window, or in



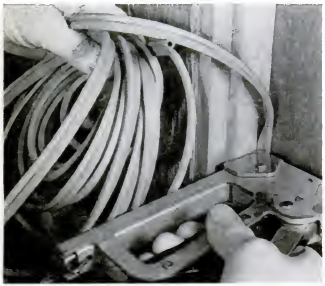
SURE CURE FOR CASEMENT WINDOWS, this U-shaped vinyl-plastic strip is glued to edge of metal frame, and window swings tight against it. Strip is easily mitered at corners with shears.

METAL SPRING STRIP can be concealed in hinged or sliding windows. For double-hung type, strip is slid up between the sash and the frame and tacked in place without removing the sash.



WEATHERSTRIP KIT for double-hung windows includes metal strips where sashes meet midway (above, left) and at top and bottom (center). Carry side strips at least 1" beyond window travel so sashes can't catch and jam. Interlocking metal strips, nailed to face of sash and frame (right) are more conspicuous but quicker to put on.

DOOR KITS include this special metal strip that's tacked behind the lock striker plate. Tin snips—or even an old pair of scissors—are all you need to cut the metal strips to desired length.



STAPLING GUN speeds tacking of this vinyl-plastic tubular strip, or you can even thumbtack it on. It works well on doors or hinged windows, but will wear fast if used on sliding sash.

BIG COILS OF FELT save you money and are quick to put on. This metal-backed type is predrilled for fastening, comes with nails and can be turned around corners without cutting.

larger hanks 25′ and 50′ long for about a cent a foot. The standard width is ¾″. It is tacked with ordinary carpet tacks to the window frame or the door-stop molding. It won't stand up long around a door or window that is often opened.

• Wool felt—sometimes a mixture of wool and cotton felt—comes in rolls up to 100′ and in two widths, ¾″ and 1″. It's put on like hair felt, but is better looking and will last longer. It costs a little more than hair felt.

For two to three cents a foot, there's a rubberized wool felt with adhesive backing that sticks to wood or metal without tacking. This is especially good for sealing metal window sash, but the adhesive won't take much opening and closing.

One of the most common types of weatherstripping is wool felt backed up by metal—aluminum, zinc or brass. It will give you a neat, though still visible, job and will stand up well. It's easy to put on, can be fitted around corners without cutting, and comes in convenient coils long enough to seal one door or window. However, it can't be used on metal sash. Price: about four cents a foot.

Wool felt backed by wood is another combination. This comes in 7′ lengths and widths from ½″ to 1½″. The narrow stuff is used to seal windows, the wide for doors. Because the wood can be painted or stained, this weatherstripping makes a relatively inconspicuous seal. It costs about twice that of metal-backed felt and is a little more trouble to install—it must be mitered at the corners.

A newcomer is a woven-wool pile, like rug material. It comes in different shapes, seals well and cushions against rattle, but costs somewhat more.

• Cotton weatherstripping has a covering of weather-repellent fabric with a core of cotton yarn. This is tacked to the window frame and door-stop molding. It won't stand up very long if doors or windows are used much. The dealer keeps it on a reel and will pull off as many feet as you want. The price is around four cents a foot. Although it is inexpensive, its short life and appearance are against it.

Plastic seals: The most common are round vinyl-plastic rolls, either hollow inside or filled with urethane foam. They are tacked to the window frame or door-stop molding in the same way as the

gasket-type fabric seals. Although the same shape as the cotton, they look much neater and give much longer service. The cost is just over twice that of cotton.

You can also get special shapes for double-hung windows, metal sash, doors and garage doors. These are easy to install, stand up well and look neat.

An expensive but especially trim-looking type is an aluminum strip edged with vinyl plastic. Another newcomer is a rounded, rigid-plastic molding strip that grips a soft-plastic seal. There's also a wood-backed vinyl-foam strip that's less expensive, and the wood can be painted or stained to match the woodwork.

To seal the bottom of a door, there are wood or aluminum thresholds that grip a vinyl-plastic roll down the center. You remove the existing threshold if there is one and replace it with one of these, cutting off the bottom of the door to fit. If no threshold exists, then more of the door bottom will have to be removed. The cost of these thresholds, either wood or aluminum, is around $1 a running foot.

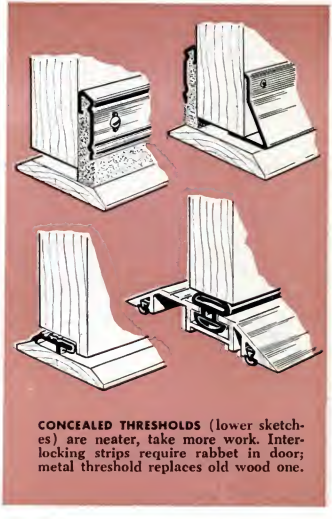
Metal seals: Bronze, aluminum, brass and stainless-steel weatherstripping will give you a permanent installation, and in most cases the seal is concealed. For doors and wood windows, either double-hung or casement, there are two main types—the "V" or folded-back kind, in widths of 5/8", 7/8" and 1 1/8", and the spring-strip type, in widths of 1" and 1 1/4". Both get their seal by the pressure of light springy metal.

The spring-strip kind is the least expensive of the metal seals. You can buy just enough to do a window or door, or you can buy it in 50' or 100' rolls for about five cents a foot. It is easy to install. You cut strips to length with scissors or tin snips, and nail it—nails come with the strips—to the window or door frame with the spring side toward the window stile or the door stop.

The V-type weatherstripping is sold in kits. Each kit has enough parts for a standard door or window. Included in the door kit is a special piece of folded metal to seal around the strike plate. The window kits have special members to seal between the cross rails.

A less well-known type of metal weatherstripping, especially for double-hung windows, is surface-mounted. It is a pair of interlocking channels, like hands hooked together. These are fastened to the sides of the windows. The seal at the top and bottom and between the two sashes is made with spring-strip metal.

EASIEST DOOR-BOTTOM SEAL to put on is this metal-backed felt strip. It's screwed to inside edge (top sketch at left, below), can be combined with rain shield tacked on outside.

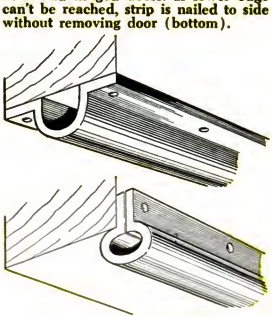


CONCEALED THRESHOLDS (lower sketches) are neater, take more work. Interlocking strips require rabbet in door; metal threshold replaces old wood one.

You needn't remove the sash to install either interlocking or spring-strip weatherstripping. But another kind calls for the conversion of weight-lifted double-

TWIN PLASTIC TUBES for garage doors come joined with metal eyelets. You just nail through the eyelets into the bottom edge of the door. Tubes are filled with urethane plastic foam.

U-SHAPED PLASTIC STRIP fits both overhead and hinged doors. If lower edge can't be reached, strip is nailed to side without removing door (bottom).



hung sash to spring-lifted. The stiles and parting strips have to be pried off and the sash removed from the window opening. The sash has to be trued up to exact dimensions, then grooved to take metal guide strips. These provide smooth-working windows and a tight weather seal, but are the most costly weatherstripping and the hardest to install.

Metal sash, either steel or aluminum, calls for a different type of metal seal. A "W"-shaped strip clips over the hinge side, and top and bottom of the frame. A "Z"-shaped member slides over the lock side. These are quick and easy to install, and the price is about $1.50 for each window.

Metal door-bottom seals can be bought separately or are included in kits. One all-metal type consists of two interlocking metal parts, one for the bottom of the door and the other for the threshold. To install these, you have to remove the door and plane or rabbet the bottom so that the part you fasten to the door will fit accurately into the piece on the threshold. This can be a tricky operation.

A simpler type of door bottom is a metal-backed felt strip that is screwed to the face of the door at the lower edge. Another type, equally simple to install, is for doors which must swing back over a rug or carpet. A spring device allows the felt seal strip to lift when the door is opened and gives it clearance.

Costs of these door bottoms ranges from 50 cents for the simple metal-and-felt type to $2.50 for the spring-lift kind.

Kits speed the work. Most types of weatherstripping are available in kit form —with enough material and parts for a standard door or window. You don't have to measure each window and door in your house to get the amount of material you need. You just count the units you want to seal and buy that many kits.

Where you can buy weatherstripping in bulk form, you will save from two to four cents a foot. But your choice will be limited largely to the inexpensive gasket seals—felt, cotton, sponge rubber and vinyl plastic.

You can also buy the spring-strip metal type in bulk form, but if you use this to seal a door, the bulk type won't include the special little metal part for the striker plate. The spring-strip kits do include this. END

The POPULAR SCIENCE Shop Notebook

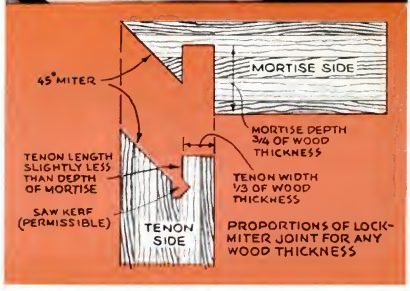
How to Make a Lock-Miter Joint

For a good-looking cabinet corner with built-in strength, try the lock-miter joint. Unlike the plain miter, which allows meeting edges to slide when brought together on slippery glue, the lock-miter holds the parts in position while the glue sets.

Easy to make with a tilt-arbor table saw, the lock-miter joint is ideal for plywood construction since it conceals the edge laminations. The cuts made on the joined edges are different, one having a miter and mortise, the other a miter and tenon. Always cut the mortise in the *long* side as the tenon must be cut while the panel is held vertically. Precut the pieces to exact size before making the joint cuts; the miters will be sawed to the edges.

To cut the joint accurately, use a tilt-arbor table saw. The left side of its fence should be faced with a straight piece of wood so the blade can nick into it when cutting the miters. A dado head is useful for cutting the mortise, but the cut can be made in several passes over the saw blade to get the required width. A set of jigs made by cutting each successive operation in a separate piece of scrap plywood will make cutting the lock-miter joint almost automatic.

The drawing at right illustrates the cuts made in both meeting edges to produce the lock-miter joint. Dimensions are given in *proportions* relative to the wood thickness rather than in inches, so the joint can be accurately made regardless of the thickness of the material being joined.



Please turn the page for cutting details

The POPULAR SCIENCE Shop Notebook

Cutting the mortise side of a lock-miter joint

CUT THE FIRST MITER on the mortise edge with the blade tilted 45 degrees and raised level with the top (good side) of the lumber. Before making the miter cut, slide the fence into the spinning blade just enough to bury the blade's thickness in the wood facing.

ASSEMBLE DADO HEAD to cut a dado ¼" wide (for ¾" lumber) and adjust the fence so that the cut begins exactly at the inside edge of the miter. Elevate the saw arbor to make the depth of the dado approximately three-fourths the thickness of the piece of lumber.

MAKE FINAL CUT in the mortise side of the joint by passing the piece over the dado head. Cut all mortise edges at one time to save resetting the saw. Keep blades sharp to get clean edges that require no sanding. Press pieces of wood flat on the table to get full depth of cut.

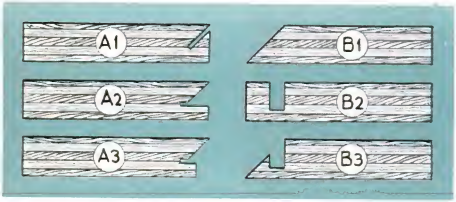
Cutting the tenon side of the joint

TENON SIDE of the joint starts with a 45-degree cut halfway into the edge. Piece must be held vertically, which is why tenons should be cut in the shorter, easier-to-handle pieces. Maintain firm side pressure on the piece to keep it upright and snugly against the fence.

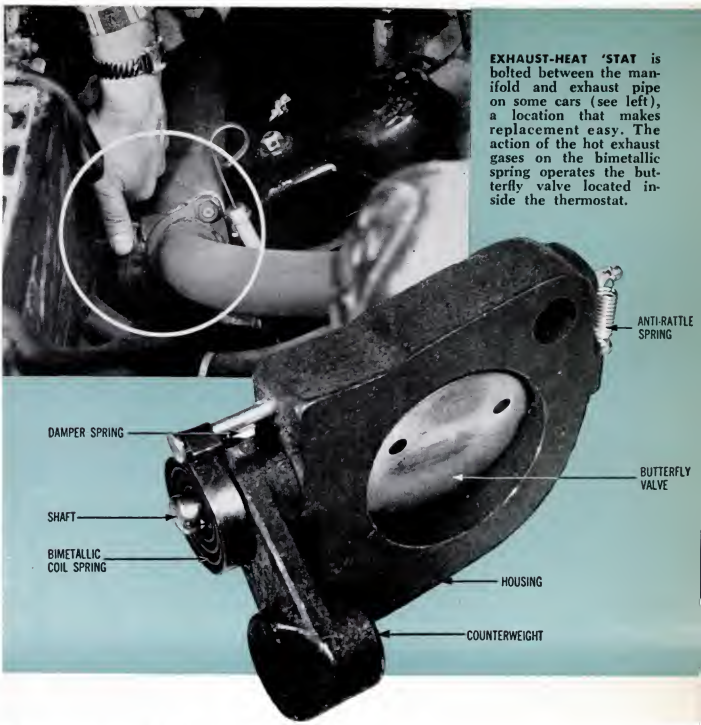
CUT AWAY TRIANGULAR STRIP of scrap to expose half-miter and produce the tenon. No harm is done if this cut undercuts the end of the miter. Set the fence slightly less than ¼" (on ¾" stock) from the blade so the tenon will fit easily into the mortise of the mating piece.

TRIM END OF TENON to fit the depth of the mortise. It's best to have the tenon fall a bit short of touching the bottom of the mortise, to provide space for glue. Practice these cuts on pieces of scrap before cutting into large pieces of good lumber, or, as below . . .

These jigs will make the job easier



MAKE A SET OF JIGS like these to simplify the saw adjustments. A1, 2 and 3 show the cuts for making the tenon and miter. B1, 2 and 3 show cuts for the mortise edge. Note that jig B2 is not mitered, to facilitate setting the dado head. Use the jigs to set blade height and fence position for each cut. Check the settings by sliding the pieces over the blade before turning on the saw. Blade should just lightly touch the jig.



EXHAUST-HEAT 'STAT is bolted between the manifold and exhaust pipe on some cars (see left), a location that makes replacement easy. The action of the hot exhaust gases on the bimetallic spring operates the butterfly valve located inside the thermostat.

Warmup slow? Engine sluggish? Then you'll want to know about:

The Damper in Your Car's Exhaust

By Phil McCafferty

DID you know you have a heat riser under the hood of your car? Or an exhaust-heat thermostat, a crossover valve, a manifold heat control, an exhaust damper?

All of these terms apply to the same thing, a little gadget that looks like a pint-sized stove damper. On V-8 engines, you usually find it at the outlet end of one of the exhaust manifolds, between the manifold and exhaust pipe on dual-piped cars; between manifold and crossover pipe on

single-piped cars. On sixes look for it in the exhaust-manifold casting beneath the carburetor.

What it does. You probably start off better in the morning after a hot cup of coffee. And in a not too different way the exhaust-heat thermostat gets your car started off quickly and economically.

Its purpose is to direct hot exhaust gases past the base of the carburetor when the engine is cold. Warmth from the exhaust aids vaporization as gasoline is mixed with air in the cold intake manifold.

The unit consists of an off-center butterfly valve mounted on a free shaft across the exhaust manifold. A small counterweight and circular-wound bimetallic spring are attached to the end of the shaft. The counterweight tends to help the off-center butterfly open as the pressure of the exhaust hits it, while the bimetallic spring tends to hold the valve closed.

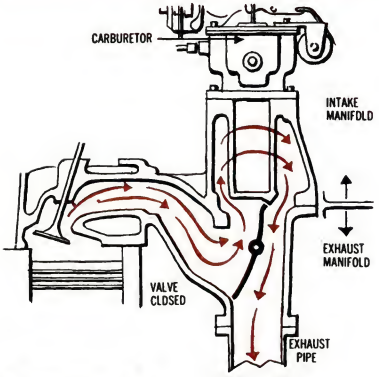
After a few minutes of engine operation, the exhaust manifold—and spring—become hot. The bimetallic spring slowly loses tension and allows exhaust pressure, plus the counterweight, to force the butterfly open. The exhaust gas then passes straight out through the muffler.

Troubles. They don't always work properly, however. Often after about 10,000 miles or so of unattended operation they freeze up tight.

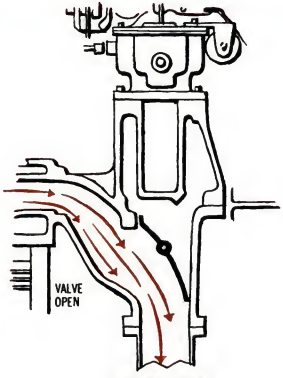
Unfortunately they may freeze closed, causing 750°-1,000° exhaust gases to pass continually through the intake manifold jacket. This means more back pressure and poor fuel economy. The cylinders cannot draw in as much gas-air mixture because the overheated mixture is too thin. The restricted gases can even warp or crack manifolds and damage exhaust valves.

On the other hand, if the valve sticks

Exhaust-heat thermostat warms the incoming fuel mixture



COLD ENGINE



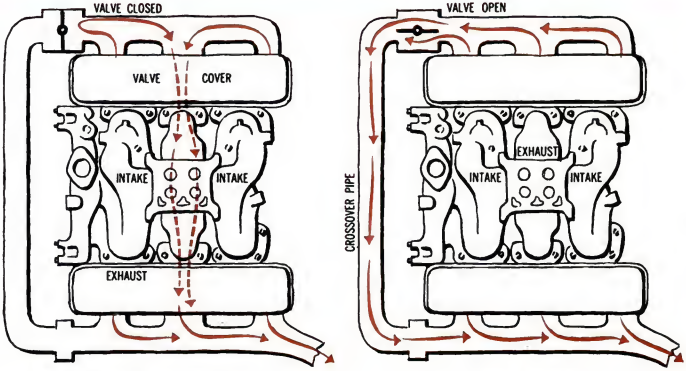
WARM ENGINE

6-CYLINDER

HOW IT WORKS: On a six-cylinder engine, the thermostat's butterfly channels the exhaust around the intake manifold, then out the tailpipe. When it opens, gases head straight for the tailpipe. V-8 manifolds (on facing page) are more complex, even when the automobile has only one tailpipe. The thermostat closes the exhaust crossover pipe, and gases from

ONE STEAMING TAILPIPE on a dual-piped V-8 indicates that the heat thermostat is doing its job. When the engine warms up, the thermostat opens, letting gases out both pipes.

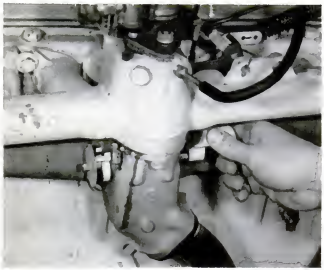
until the engine gets hot enough to operate normally



V-8

the right manifold must pass under the carburetor to get to the left manifold and out. When the butterfly opens, exhaust flows normally through the crossover pipe. On a dual-pipe installation (not illustrated), the crossover pipe is omitted. The thermostat closes the right exhaust pipe, forcing gases under the carburetor to the left side.

SIX-CYLINDER HEAT THERMOSTAT is squirreled away inside the exhaust manifold, making the unit hard to get at. On this type, it pays to free a stuck shaft with graphite paste and replace the coil spring, if it's weak.



JIGGLE THE COUNTERWEIGHT occasionally to keep it free, and check its action by briefly accelerating the engine. The counterweight should respond to acceleration by moving ½", and then should return to its normal position.

DUCKBILL THERMOSTAT shown above was used on postwar Fords. Pressed into the manifold outlet, it "closed its bill" when heated and exhaust gases passed around the two disks. But it rusted easily and was hard to replace.

open, the car will be sluggish during warmup—and warmup will be slow. The heat that causes the automatic choke to open on cars equipped with such chokes is usually taken from this same jacketed arm. If the exhaust thermostat is frozen open, it will take longer than normal for the choke to open, giving an over-rich mixture during the warmup period. This condition can cause spark-plug fouling, not to mention shortened engine life as raw gasoline washes vital oil off cylinder walls.

If these troubles aren't enough, heat thermostats may rattle, chatter and leak exhaust gases.

Chatter is easy to fix. If the counterweight chatters upon acceleration or let-up, it is likely caused by a weakened spring. This is easily removed from the shaft with a screwdriver and replaced.

Sticky or frozen thermostats are tough to fix. An attempt to free a frozen shaft can be made by tapping the ends of the shaft with a small hammer while trying to rotate the counterweight.

If patient effort fails to free the shaft, or if the unit is worn so badly that exhaust whistles through the shaft bearings, replace the whole unit.

The V-8 thermostats are usually replaced as a unit, since the butterfly is probably welded to the shaft after assembly. Removal of two manifold bolts frees the part.

But prevention is better than curing. To head off the trouble, check for free action by giving the counterweight a couple of twists each time you check the oil.

To get at six-cylinder thermostats, you must remove at least the intake manifold, if not the exhaust manifold. The shaft can then be driven out of the manifold.

Never oil them. Using oil to free or lube a sticky shaft is out. Even penetrating oil will carbonize and stick up the shaft tighter than it ever was. A thin mixture of alcohol and powdered graphite applied to the shaft bearings works better, or the shaft can be sprayed with an aerosol rust solvent. The spray can will put the solvent where a brush couldn't reach.

A sticky-thermostat remedy that many mechanics use is this: Squirt a little cola-drink into the shaft bearings while the engine is hot, at the same time operating the thermostat by hand. Don't ask us why, but it helps. END

AC HOT TIP SPARK PLUGS... packed with

...and so thrifty on gas that a new set can save you three times their cost!

If the spark plugs in your car have gone ten thousand miles or more, you'll be 'way ahead replacing them with a set of new AC Hot Tip Spark Plugs. You'll notice at once how the new set of ACs brings back a satisfying like-new car performance!

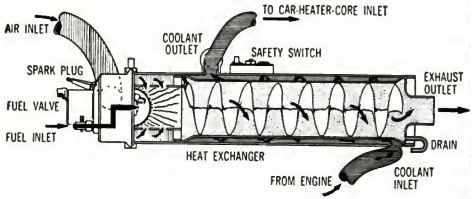
You will notice, too, that you are beginning to save money on gas! A new set of ACs can save as much as one gallon of gasoline out of every ten you buy. That's because the exclusive Hot Tip burns off fouling carbon and other deposits, keeps them clean-burning to assure efficient fuel combustion.

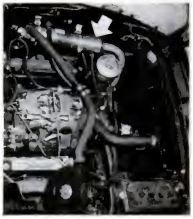
On the average, the kind of gas saving ACs can give you would pay for the new set three times over. With top performance and important savings at stake, you can hardly afford to delay. Change now to a new set of AC Hot Tip Spark Plugs. Start saving—and start enjoying your car more.

ACTION starts with AC GM **HOT TIP SPARK PLUGS**

AC SPARK PLUG THE ELECTRONICS DIVISION OF GENERAL MOTORS

New for Your Car





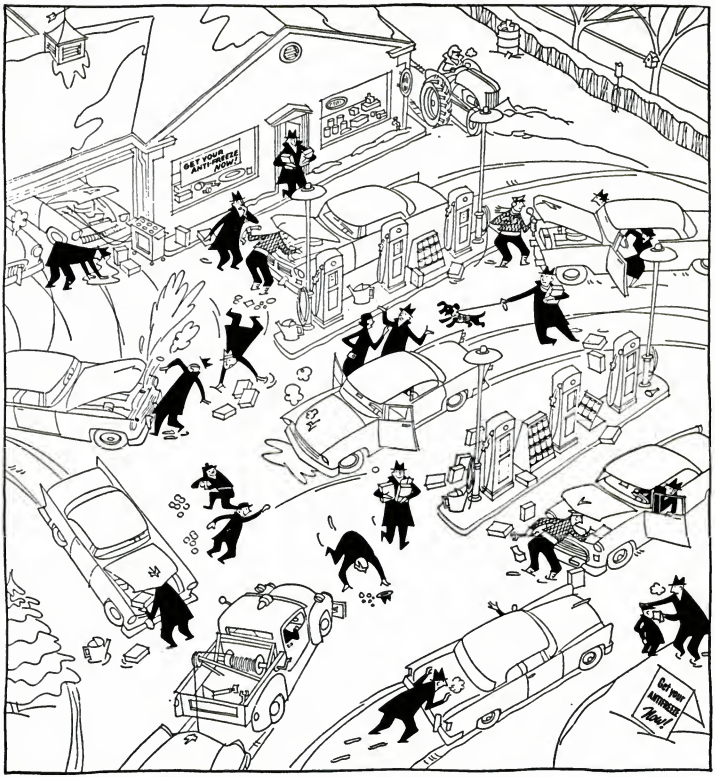
1. Heater Warms You and Your Engine. If your car is a 1949 or later model, you can equip it with a gasoline-fired heater that quickly heats the cooling system to normal running temperature, independently of the engine. Besides quicker heat from the regular heater in the passenger compartment, other benefits claimed are: quicker engine-block and oil warmup; less oil contamination from condensation; fuel economy through better carburetion and shorter choke period; quick defrosting of fogged windows. When the coolant reaches 160°, the heater shuts off automatically and remains off unless the coolant drops below 140°. Then it will turn itself on to boost the cooling-system temperature back to 160°.

The coolant-heater kit—a gasoline burner and heat exchanger, air blower, spark breaker, spark coil and switch—can be installed in about an hour, says the manufacturer. The parts can be removed and reinstalled in later cars with similar engines. The kit is shown (arrow) installed in a late-model Ford V-8.

2. Safety Lock Guards Rear Door. This plunger slides into a door handle, locking it rigid so that a child can't open the door until a key is used to release the plunger. The plunger, mounted on a base plate, is slipped over the handle's shaft, then the handle is put on without its retaining pin. The plunger goes into the pin's hole, preventing the handle from turning. A red warning ring shows when the door is not locked. The device comes in pairs for 1957 Chryslers, De Sotos, Dodges and Plymouths.

3. Powdered Lubricant Is Clean. Almost white in color and said to be even finer than face powder, this new powdered lubricant can be used on door locks, hinges, fishing reels, guns and even on zippers where ordinary lubricants might be messy. To apply it, you simply insert the tip or aim it at the object to be lubricated and then squeeze the flexible-plastic bottle.

More information *about these products can be obtained from: 1. Stewart-Warner Corp., 1826 Diversey Pkwy., Chicago 14; 2. MoPar Division, Chrysler Motors Corp., P.O. Box 1718, Detroit 31; 3. Dry-Lube, 337 Cass St., Peoria 2, Ill.*



FAMOUS LAST WORDS—

"I'll get my antifreeze tomorrow!"

Why go through this again—take steps now!

1. Take your car to your regular serviceman.

2. Give him time for a complete check of the entire cooling system.

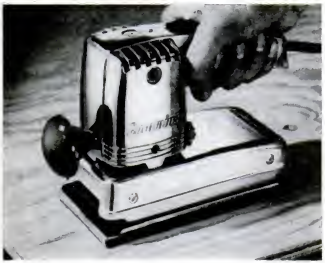
3. Ask him to install his company brand of glycol all-winter antifreeze.

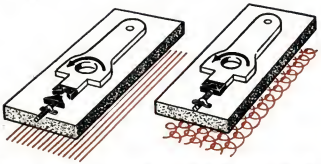
Three easy steps right now . . . and you're ready for carefree winter driving!

Dow is a leading producer and supplier of ethylene glycol to the antifreeze industry.

The Dow Chemical Company, Midland, Michigan DOW

New Tools





1. Sander Works Two Ways. Orbital motion for rough sanding and in-line motion for finishing are combined in this double-action sander. To sand with orbital motion, you use a key to lock a drive plate firmly to the sanding shoe. The eccentric action of an offset drive bearing on the motor shaft is transmitted through the drive plate to the shoe, producing the orbital motion. When you back off the lock screw with the key, one end of the drive plate pivots on a nylon bearing while the driven end is released from its attachment to the sanding shoe. Now the offset drive bearing causes the drive plate to operate like a connecting rod, moving the shoe back and forth in an in-line motion for sanding with the grain. A counterweight on the offset drive reduces vibration. Standard sheets of sandpaper cut into three equal parts can be used with the sander, and "rat-trap" clips hold the sandpaper strip firmly on the shoe by spring action.

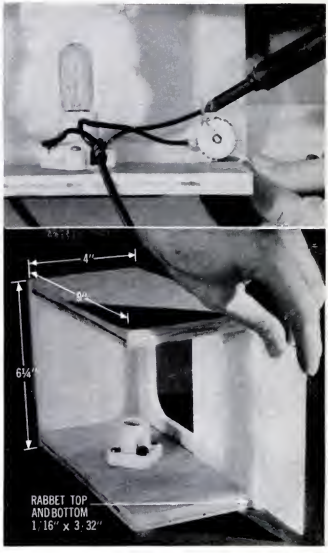
2. Compass Makes 12-Foot Circles. Not much larger than a half-dollar, this beam compass can reel out enough tough linen thread to scribe circles up to 12′ in diameter, as well as large spirals, ovals and other special shapes. Working on the old string-and-tack system, its line can be controlled to a fraction of an inch by a locking clutch and rewind knob. A socket at the end of the line will hold a pencil, ball-point pen or metal scriber for laying out wood, paper or metal.

3. Drill Kit Handles Problem Jobs. This set of drill attachments is designed to overcome many problem drilling jobs and save the cost of replacing broken drills. The kit contains a drill-extension rod, flexible coupling with handle, extension-chuck adapter, five sizes of extension chucks, five small collets, three large collets with adapter, and a drill-saver adapter for use with broken drills. The tools add more than 10″ to drill lengths and aid in close-quarter drilling.

More information *about the tools on this page can be obtained from: 1. Cummins Portable Tools, 5055 N. Lydell Ave., Milwaukee 17; 2. Loramic Chemical Corp., 290 Main St., Stamford, Conn.; 3. Kitmar Corp., 183 New York Ave., Huntington, N. Y.*

Short Cuts and Tips

FROM PS READERS



Night Light Looks Like TV Set

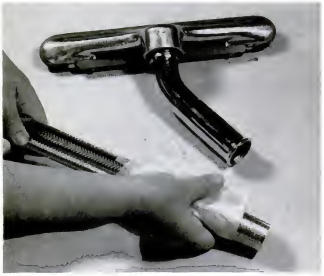
THIS make-believe TV set will bring a soft glow to a nursery at night. The screen is a piece of $\frac{1}{16}$" ground glass with a decal on the smooth side. It fits a groove in the top and base of the ¼"-plywood cabinet. One "tuning knob" covers a rotary on-off switch for a 7½-watt bulb; the other is just a dummy.

Assemble the cabinet except for the back, gluing all joints, and slide the glass into the grooves. Then mount and wire the switch and lamp socket. Drill four or five vent holes in the back. Then, before screwing the back in place, knot the wire and draw it through one of the holes. Four rubber-headed tacks make feet.—*R. J. Capotosto, Flushing, N. Y.*

Short Cuts and Tips

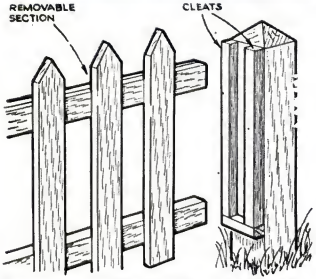
Auto Starter Drives Mower

My old hand mower is now run by a six-volt, battery-fed automobile starter. I use two belts and an idler pulley to reduce speed between the motor and the driven reel. To take power off the reel for propulsion I reversed the driving dogs and pinions inside the mower's wheels. The mower cuts 10,000 square feet of lawn on one battery charge.—*Victor P. Salvatore Jr., Poughkeepsie, N. Y.*



Wax Paper Lubes Wand Joints

When they are new, vacuum-cleaner extension tubes and attachments sometimes fit too snugly to be separated easily. Rub the ends occasionally with wax paper and they will slide on and off with less trouble.—*Harvey R. Colpe, Alexandria, Va.*



Removable Fence Saves Work

My picket fence has rail sections held in place by cleats on the sides of permanent posts. By simply lifting out the sections I can mow across the line or paint the fence without squatting.—*John A. Comstock, Wellsboro, Pa.*

Blunting Nail Protects Wood

Before driving nails into wood that has a tendency to split, flatten the points slightly.

Blunted points shear through the fibers of the wood instead of spreading them apart.—*R. J. De Cristoforo, Los Angeles, Calif.*

Farm Scrap Makes Springy Seat

Welding one end of an old car shock-absorber spring to a disk-harrow blade, and the other to a pressed-steel sulky seat, makes a comfortable stool for a workshop—or just plain outdoor sitting. —*A. M. Wettach, Mt. Pleasant, Iowa.*

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Here's why the MAGNA 9-IN. TILT ARBOR SAW tops them all: • *Increased Capacity*—exclusive "Helping Hand", a built-in table extension permitting rip cuts up to 26", 125% more effective table area! • *New Ease of Operation*—one-knob control for blade height and tilt, exclusive Speed-Gear (45° tilt in only 10 turns, no roll-back!) • *Integral Precision*—self-aligning fence locks *down* front and rear with one knob! • *Rugged Durability*—solid-cast tub front with self-contained trunnion; massive cast-iron carriage! Basic Saw only $119.95, delivered! (MAGNA 8" T/A Saw only $66.88.) Mail coupon today for *free Magna-Line* catalog!

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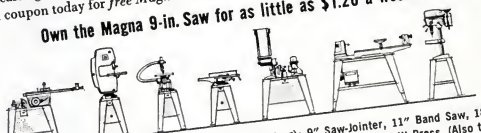

MAGNA-LINE tools for home and industry include (l to r): 9" Saw-Jointer, 11" Band Saw, 18" Jigsaw, 4" Jointer, 6" Belt Sander, Compressor-Sprayer, 30" Lathe, 12½" Drill Press. (Also the new MAGNA Thrifty-Three: 8" T/A Saw, 12½" Jigsaw, 4" Belt Sander.)

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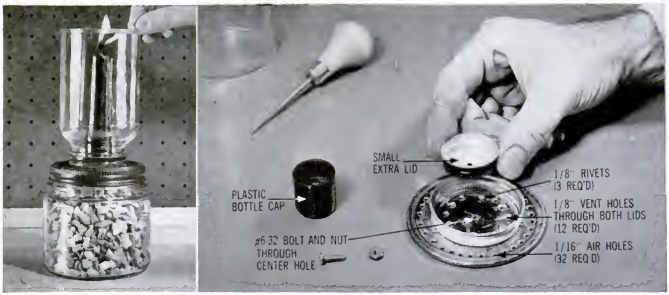
Short Cuts and Tips

Boat Back Rest Drops into Cleats

A SIMPLE setup provides me with a back rest for my boat. I just drop a piece of marine plywood through a brace on the edge of the seat and anchor it between cleats screwed crosswise on the floorboards.

A 20″ length of strap iron, bent to take the board, made the brace. The cleats were ripped at an angle to give the back rest a comfortable slant for sitting.—*W. H. Holm, Muskego, Wis.*



Candle Burns Without Flickering in Coffee-Jar Hurricane Lamp

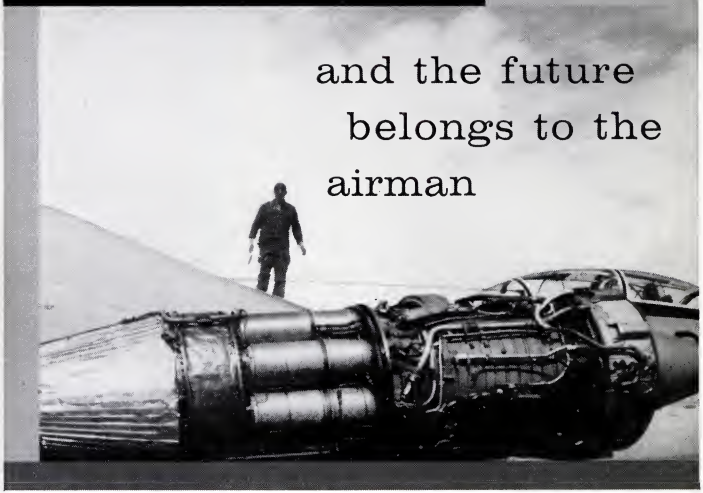
A HURRICANE lamp that really works can be made from two jars and some lids. An instant-coffee jar is just right for the chimney, while a squat jar of the type used for peanut butter makes the base.

Clamp a glass cutter to the bench and rotate the bottom of the smaller jar against it firmly to score it all around. Tap the bottom until it falls away at the scored line and smooth the cut by rubbing the jar's end on a piece of flat glass coated with wet abrasive grains.

Assemble the two jar lids, a third, smaller lid to catch drippings, and a plastic bottle cap big enough to hold a candle. Fasten them together with a small bolt through their centers. Punch $\frac{1}{16}$″ holes through the lid of the base and $\frac{1}{8}$″ holes through the chimney lid *and* base lid. Complete the assembly with three $\frac{1}{8}$″ rivets in three of the $\frac{1}{8}$″ holes.

The nine remaining holes supply air to the candle through the bottom of the chimney. Fill the base with colored aquarium stones or sea shells to add weight.—*Walter E. Burton, Akron, Ohio.*

The new age of space is here...



You have read about the early Age of Flight...grown up in the Jet Air Age. Now, as a young man, you stand on the threshold of a new age in which man will conquer outer space. It will be the age of trained technicians—those who have backgrounds in rocketry, jet propulsion, electronics, mechanics and allied fields. And nowhere else is such training so available or so complete today as in the U.S. Air Force. Consider this fact as you plan your future. By joining the Air Force, you will, of course, meet your military obligation. But much more important, you will prepare yourself for unlimited opportunities in the new Age of Space. See your local Air Force Recruiter today—or mail the coupon.

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AT LAST! A REALLY SAFE POWER SAW THAT TAKES THE WORK OUT OF SAWING

SENSATIONAL WRIGHT REBEL HAS NO WHIPPIN', KICKIN' CHAIN

Thousands of men are finding out that wood cutting doesn't have to be a tough, back-breaking job . . . they've heard about, seen, tried and bought themselves Wright "Rebel" Power Saws! Men who said they had no use for a power saw are today building their own boat docks; clearing trees or brush off their land; pruning trees and bushes; taking Rebels camping to gather fire-wood the *easy* way — and building the best duck blinds you've ever seen. Farmers swear by it for thousands of jobs. Sportsmen say it's the kind of saw they've been looking for. Why, in 15 minutes, they take on projects they've put off for years! And as for the routine sawing jobs . . . the Rebel goes through 'em with a speed, ease and safety you never imagined possible . . . it's as safe and easy to use as today's power mowers.

JUST GUIDE IT AND *RELAX*—The big difference between the Rebel and old-fashioned, dangerous saws is in the exclusive guarded reciprocating blade. It works like a hand saw — back and forth — only thousands of times faster. Men who've never touched a power saw before see in a minute that there are no new "tricks" to learn, you just guide it along like a familiar hand saw. And, it's safe . . . no screaming chain to fight through a cut; no grabbing or kicking as the saw enters the cut. Why, you can operate the Rebel with one hand!

HUSKY — UNCHAINED POWER — One pull of the rewind starter and the Rebel sings into action: tighten your grip on the safety throttle-trigger, and place the saw on the wood — smooth! You'll notice the lack of vibration, yet the blade is slicing away at 10,000 strokes per minute. Then you'll notice the narrow cut — narrowest of any power saw. The smooth mill-edge finish is another Rebel exclusive . . . not only can you fell a tree — but you can do finish sawing, too. And, best news of all, the full cost, including blade, is far under other power saws — of comparable size and features!

LITERATURE AND DEMONSTRATIONS—Start sawing the easy way: get all the facts in our illustrated folder. Send 10¢ for folder and the name of your local dealer who'll give you an on-the-job demonstration on your own property. Write to: WRIGHT POWER SAW AND TOOL CORP., Dept. 58-J, 410 S. Third Street, Louisville 2, Ky. (Dealerships available — write to department 8-Y.) Distributed throughout the United States and Canada.

A HAMMER, NAILS AND A WRIGHT REBEL . . .

is all it takes to build a cabin like this. Only the Rebel makes all the cuts necessary: fells trees, notches logs, cuts square tennons . . . everything!

FOLLOWS A CHALK LINE . . .

without "wandering" . . . you guide it and relax because the Rebel feeds itself—leaves a smooth mill-edge finish. It's the only power saw that does *true* precision-cutting.

Send 10¢ for illustrated "Easy Steps to Wood-cutting" booklet . . . shows dozens of do-it-yourself projects for fun and profit! Wright Power Saw and Tool Corp., Dept. 58-J, 410 South Third St., Louisville 2, Ky.

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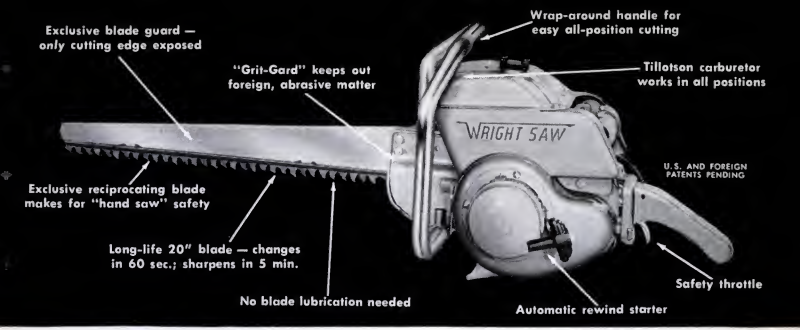
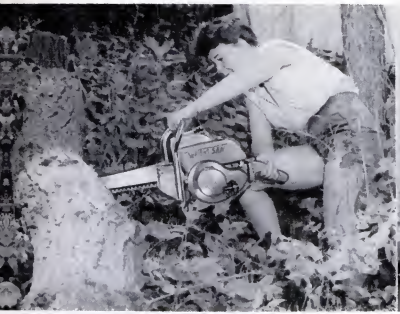


It's The Power Saw of The Future! Note the unique design and many safety features . . . the Rebel *looks* different because it *is* different — it's the only power saw that works on the time-proved hand-saw principle.



Women Or Youngsters Can Do It! Neither strength nor skill is required to handle the lightweight, super-safe Rebel. Smooth, self-feeding cutting action—"just guide it and relax."

Pays for itself in one job—Own a boat? Then build your own pier or boat dock and save more money on one job than the entire cost of the saw! Gasoline-powered . . . use it anywhere — even miles from town!

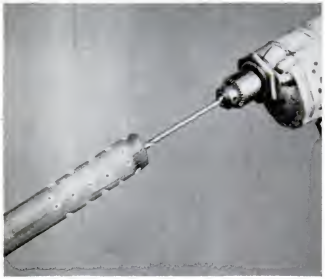
Easy to sharpen as a hunting knife. No special tools—no gauges or measuring devices. Zip, zip, zip — in 5 minutes you're done! And, you can change blades in less than 60 seconds.

Improve your property—build a rustic fence; bridge a ravine; clear out shrubs and undergrowth; trim hedgerows; build a play house or garden "tea house." They're easy—and fun—with a Wright Rebel.

Short Cuts and Tips

Camera Takes Off-Size Film

WHEN I can't buy No. 120 film for my No. 120 camera, I adapt a roll of No. 620. A short 3/16″ steel rod, filed or ground to a 3/32″ taper at the tip, does the trick. A few light hammer taps drives it in each of the spool's end slots to enlarge the opening enough for the pin to drop in. This works for any 120 camera.—*B. Linger, Rochester, N. Y.*



Handle Vents Improve Hammer

YOU'LL grip a hammer better on sweaty or greasy jobs if you drill a series of small radial holes through the sides of its handle. Countersink these ventilators to remove sharp or splintery edges. Then connect the holes with a larger one drilled axially from the end of the handle.—*H. J. Gerber, Stillwater, Okla.*

Wood Chip Hides Nailhead

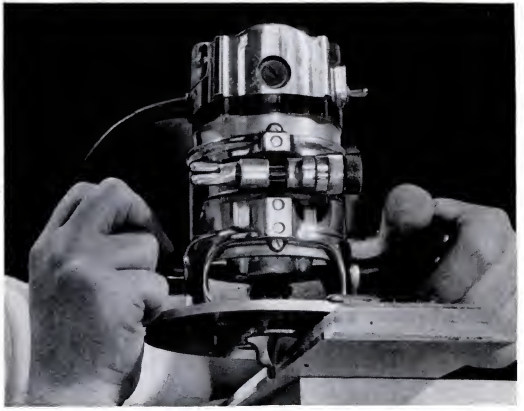
TO HIDE a nailhead in soft wood, lift a clean chip like this: Break a thin double-edged razor blade lengthwise. Grasp the ends of a broken half between thumb and finger and bend it into a deep curve. Then force the sharp edge into the work at an angle. Chips lifted in this way will glue down over a nailhead so that the cover-up job is practically undetectable.—*Kenneth Morgan, Detroit.*

▸▸▸ TO LOCATE quickly a nail or a screw of the size required for the job at hand, I snap a rubber band around each container and slip a sample of the contents or a label from the box under the band.—*W. N. Skourup Jr., Des Moines.*

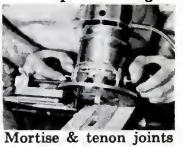
Sandpaper Puts Edge on Cutter

GOT a paper cutter that chews its way through the sheets? Make a few cuts through a piece of sandpaper or other abrasive sheet and your blade edge will get a new lease on life. Be careful to keep the grit side up so that you sharpen only the moving blade—not the metal guide edge.—*F. A. Jones, Kearny, N. J.*

New Black & Decker 3/4 HP Heavy Duty Router ...the complete woodworking tool!

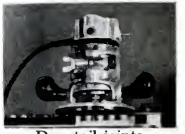


Template routing



Mortise & tenon joints

Molding cuts



Dovetail joints

Dado cuts

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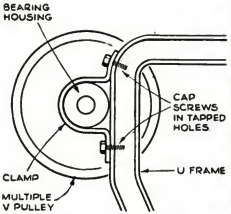
Short Cuts and Tips

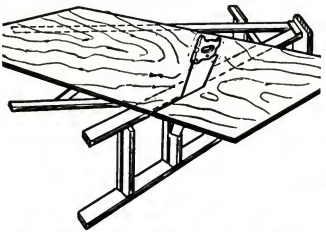


Bandsaw Is Slowed Down to Make Motorized Hacksaw

AN OLD bandsaw fitted with a jackshaft to reduce speed saves me the sore muscles I used to get pushing a hacksaw. It cuts through ½″ iron and sheet metal the way it used to cut through plywood.

I mounted the speed-reducer pulley on a discarded table-saw arbor since its speed is so slow that a light bearing serves. A ¼-hp. washing-machine motor supplies power and is hung so that gravity keeps the belt tight. This is important, because if the saw sticks, the belt will slip, relieving pressure on the blade.

A fairly coarse metal-cutting blade works best on the saw, which remains unchanged. A fine-tooth blade fills up—especially on aluminum—and wears faster.—*Charles T. Pearson, Ypsilanti, Mich.*



Ladder Doubles as Sawhorse

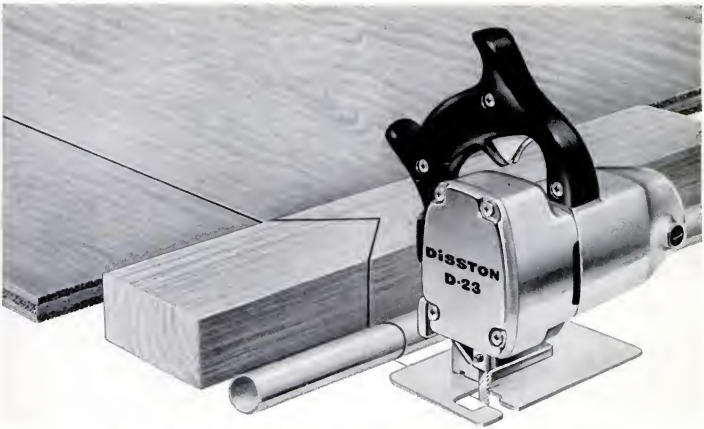
IF YOU'RE faced with the job of handsawing large sheets of plywood and lack sawhorses, haul out the stepladder. Opened and laid on its side, it makes a good support.—*Jack Norris, Madison, Wis.*

Wallet Holds Photo Data

A SNAPSHOT wallet will serve as a pocket library of exposure data and other photo information. Cut out the printed material that you want handy for reference and slip it into the transparent pockets.—*Hugh F. Williamson, Butte, Mont.*

▶▶▶TO STRIP off wallpaper, I brush on a solution made by dissolving a cup of paste in three gallons of water. Paste keeps moisture from drying out of paper so fast. —*J. P. Izzo, Providence, R. I.*

▶▶▶TO SAVE on the cost of a replacement pad for a sponge mop, you can cut an ordinary cellulose sponge to fit. Fasten it to the head of the mop with waterproof cement.—*John Compton, Johnstown, Pa.*



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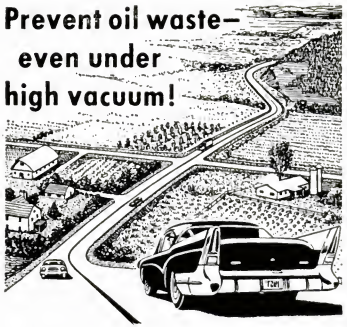

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Sealed Power

PISTON RINGS

BEST IN NEW CARS! • BEST IN OLD CARS!

Your Youngster's Science Training

[Continued from page 93]

Do they overload teachers? A science teacher has a full-time job; he shouldn't have to fill in on history or English, too—or coach the football team. Classes shouldn't be too large—30 students is the limit, 25 better.

Do they encourage teachers? The school should offer time off to attend seminars, money for books and equipment, freedom to experiment with new ideas.

To score your schools on teachers, go over each of the items above and set down your general impression. If you have collected the facts, your score won't differ much from that of a professional educator.

Laboratory facilities. Your youngster can't learn to drive a car from books. The same is true of science. He has to experiment. That's why adequate laboratory facilities are essential. They're completely missing in a third of our high schools and a vast majority of elementary schools. If your high school lacks a lab or fails to use the one it has, you can be sure that its science instruction is poor.

To find out about lab equipment, compare yours with the standards of your State Department of Education, which lists the things needed. You can get a copy of the list from your State Board of Education. Check, too, on how your school uses its laboratory. How often is it available to a class? Do students really experiment or is everything demonstrated for them by the teacher? (There'll be more about high-school science labs in next month's PS.)

Books. Look at the dates in your youngster's textbooks. Science is changing fast and, generally speaking, the newer the textbook, the better. See how much space is devoted to scientific knowledge developed since the splitting of the atom. Science instruction is out of date unless it gives students an atomic view of the universe.

Besides textbooks, your youngsters need a good reference library that includes scientific magazines.

A passing mark here requires science textbooks less than 10 years old, a library of at least 25 recent books and three or four magazines devoted to science, or an up-to-date listing of science books that

...and these

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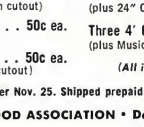

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Science-mindedness. Science teaching flourishes only in an atmosphere charged with interest. Do your schools provide it? To promote science, good schools:

- Invite speakers to talk about scientists and their work.
- Bring in college representatives to describe their science and engineering courses and scholarship opportunities.
- Stimulate interest in activities like the International Geophysical Year with posters, displays, speakers and movies.
- Feature assembly programs produced by science classes.
- Cooperate with local radio and TV stations in producing science programs.
- Organize field trips to nearby factories and labs.
- Utilize national science programs.

The Atomic Energy Commission's Oak Ridge Institute of Nuclear Studies sends out teams to put on science demonstrations in schools. The American Chemical Society, the U. S. Chamber of Commerce, the National Science Foundation and other organizations furnish speakers. The American Association for the Advancement of Science sends out "Traveling High School Science Libraries" and provides roving science counselors. Science Service of Washington, D. C., sponsors the Science Clubs of America; the National Science Teachers Association sponsors Science Achievement Awards for Students. Westinghouse Educational Foundation underwrites Science Talent Search. Programs like these (there are more than 50, all told) are available to every high-school student in the country—provided his school participates.

A "passing" mark on science-mindedness requires at least regular assembly talks or shows on science subjects, and participation in at least one national science program.

Accreditation. Experts from the Associations of Colleges and Secondary Schools inspect high schools and accredit those that meet their standards. (There are six associations, each named after the region it serves—New England, Middle States, Southern, North Central, North Western and State of California.) Only one out of four high schools in the U. S. has the ACSS okay.

If your high school is not accredited,

Two good names are always better than one

When you buy a portable electric drill look for the name JACOBS on the chuck. It is your extra assurance of top tool performance.

An electric drill is no better than its chuck... the point where the drill's power is put to work. Many heavy duty operations are performed with attachments which are held in the chuck, so a tight, accurate grip — a JACOBS grip — means better work done easier.

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find out why. It should be. If it is accredited, check whether approval was complete and unqualified or is conditional pending correction of some inadequacy.

Graduate performance. The payoff from any training is how well the student makes out after graduation. Do the ones who continue their studies have to bone up on things they should have learned in high school? Do employers of your school's graduates find them ill-equipped for technical jobs?

Colleges and technical institutes often tell a school principal how his former students are doing. Ask about these reports. And talk to local employers about the preparation of kids who go to work right after school. Recent graduates themselves can also help you grade your school on this point.

How to get action. At best, your schools will turn out to be less than ideal. Raising hob with your son's physics teacher will do little besides getting your boy mad at you. To accomplish something, plan your campaign:

Work with a group. The PTA swings a lot of weight in most school systems. Maybe yours can appoint a committee on science teaching. Don't overlook the influence of other civic organizations—Elks, Rotary, Chamber of Commerce, League of Women Voters, American Legion.

Go through channels. Your schools, like the Army and General Motors, have a chain of command. At top, the Board of Education sets policy. The Superintendent of Schools runs the outfit (he may have an assistant supervising science). The principal is straw boss over the teachers. Best procedure: Enlist the support of the good teachers, then work up one echelon at a time.

Don't act like a crank. Many school officials are bedeviled by people who want the school system to reflect some pet obsession. You'll get what you want if you are patient, understanding, sympathetic. But don't accept evasive answers or airy reassurances. Know what you're talking about, then stick with it. Intelligently managed schools, actively supported by the community, can play a vital role in determining your children's future. END

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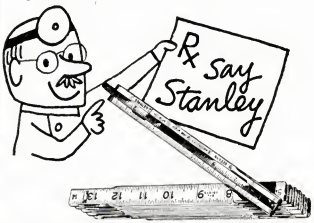

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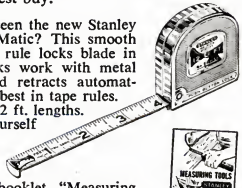

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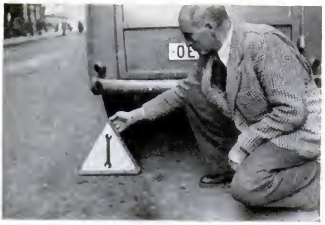

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Teen-Agers Drive School Buses

[Continued from page 120]

where, are left to School Board mechanics. Damage to the bus, or other property, is charged to the driver, if it is his fault. One boy, who carelessly smashed a farmer's mailbox, had to replace it from his pay. All insurance is handled by the state in a self-insuring pool.

State funds also provide the buses, of many makes, and the driver pay. The buses, which drivers keep at home nights, weekends and holidays, have 30-mile-an-hour governors.

"When these drivers start that bus trip in the morning," says Wilson, "they know they're riding on a good safety record, and we remind them how important a good record can be if trouble comes. Speaking of safety, I can't remember anyone killed in a school-bus accident since I came here 13 years ago."

State school officials express the same pride. The National Safety Council, in Chicago, once noted that the Tarheel drivers, in a five-year period, rolled more than 100,000 miles for each reportable accident—which in North Carolina means even a nick on a fender.

While local authorities speak of lessons pupils learn in this "highway laboratory," state men praise the system for its economy. At Raleigh, Director C. C. Brown of the Division of Transportation of the State Board of Education says student operators are saving taxpayers about $7,000,000 a year.

The best reward of all, though, comes at commencement. In these year-end moments they share the platform and honors with the class valedictorian and star quarterback. For their service, they get special certificates, as well as applause, from classmates and the community.

The first North Carolina schoolboy to haul pupils to classes commanded a farm wagon on back-country roads shortly after World War I. The story goes that the School Board had a wagon, but no driver. One of the board members stood up at a meeting and said:

"Look here now, Jim Stuart's son, out on the river road, comes into this school. He's a well-spoken lad—bright, too. He knows horses. Let him drive the rig and pick up the others on the way."

And the youngsters have been in the driver's seat ever since. END

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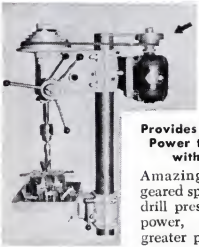

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Secrets of the Electronic Snoopers

[*Continued from page 130*]

bugging, it is hooked up to a voice-operated relay. Then the distant recorder won't run except when the mike is overhearing conversation.

Ruggles once installed a DD4 below a tiny hole he drilled in the floor of a ranch house, directly under a sofa, and ran a line from it for 1,800 feet across a plowed field to the edge of a highway. There he left the line until the time was ripe to drive up in his station wagon and link it to his tape recorder.

At another time, he helped the police nab a dope peddler by fastening a DD4 mike to the end of a long pole and thrusting the pole across an alley between apartment houses until the mike was hovering just outside a window open only a crack.

The DD4 installed under the dash of his station wagon was put there to serve clients. From time to time they have rented the car to take would-be blackmailers or unscrupulous business partners for an ostensibly private ride and record incriminating chats.

With a battery of seven DD4s hidden behind acoustical tiles in key locations within a big cannery, Mason played a vital part in busting up a ring of dishonest employees who were fleecing the company of thousands of dollars a month.

In this case, lines from the seven mikes were run to a central selector switch in the packing plant. Twenty-five miles away, at the end of a direct telephone line in his sound laboratory, Mason and assistants, working in shifts, controlled this selector switch and picked up for recording what any one of the hidden mikes overheard.

A bizarre electronic instrument called a shotgun mike is particularly effective in bringing dope peddlers to justice. Criminals are exceedingly cagey about where they meet their clients. A favorite place is a park or field, where they feel reasonably safe from eavesdropping. But the shotgun mike, when aimed straight at the speakers, fairly sucks in the sounds of their voices from a block to a quarter-mile away, depending on whether it is being used in a city or in the country. The mike is usually linked to a recorder. The man who aims it likes to have a

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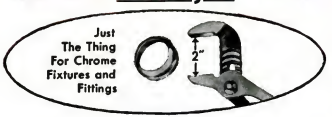

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helper along to take telephoto movies of the scene, to reinforce the evidence.

If the suspects are meeting in a park, the shotgun mike is usually set up on a roof at the park's edge. Sometimes, when movies aren't needed, it is aimed from the back of a truck that has been made to look empty by letting down the tailgate and covering the whole rear opening with fine black gauze.

A shotgun mike consists of a bundle of aluminum tubes with a large round microphone at the back end of the bundle. The tubes are all of the same diameter (one-quarter or three-eighths of an inch) but of different lengths, ranging from six inches to four feet. By the wizardry of acoustics, this peculiar-looking setup is highly directional. It picks up only those sounds that it is pointed at.

For detective agencies, Ruggles has also made a fantastic little gadget that enables an operative to listen in on a telephone conversation without tapping wires or making his presence known. The device, a transistor pre-amplifier with an induction pickup, is about the size of a book of matches but slightly thicker. It fits in a watch pocket. When it is held against the wall of a phone booth at a point nearest to the phone in the next booth, the user, who listens with one tiny earphone, can hear both ends of a conversation carried on from the other booth.

Another ingenious rig that Ruggles has devised is a means of tailing a car that is out of sight, even several blocks ahead. One part of the rig is a power transmitter, about three inches square, with a small trailing antenna. This can be secretly clamped to the frame of a suspect's car and connected to his automobile's electrical system. It transmits a continuous signal. The tailing car has a receiver tuned to this wave length, and a direction finder so it can track the signal from the car ahead.

With such an array of ingenious gadgetry readily available to anyone, it's no wonder that electronic eavesdropping is a rapidly spreading practice. Is it good or bad? The answer seems to be that it all depends on the purpose for which it is used. That's why the law is stepping into the picture—to protect the privacy of law-abiding individuals. END

New Transcription-Type Tone Arm Makes Collaro World's First True High Fidelity Changer

FREE: Colorful new catalog, containing guide on building record library plus complete Collaro line.

From Collaro Ltd., world's largest manufacturer of record playing equipment — comes the most significant development in years — the exclusive new transcription-type tone arm, which transforms the conventional record changer into a TRANSCRIPTION CHANGER, with features of the finest professional equipment.

The arm is a one-piece, spring-damped, counter-balanced unit which will take any standard high-fidelity cartridge. It is free of any audio spectrum resonances.

Stylus pressure between the first and last records in a stack remains virtually constant at less than a gram of difference, compared to 4 to 8 grams on conventional changers. Vertical and horizontal friction are reduced to the lowest possible level, insuring longer life for records and styli.

In its superb performance, the new Collaro Continental, Model TC-540, meets the rigid requirements for high fidelity equipment, offering professional quality at a record changer price. The Continental is $46.50. Other Collaro changers are priced from $37.50 up. (Prices slightly higher west of Mississippi.)

ROCKBAR Corporation

WRITE TO DEPT. P-010
ROCKBAR CORPORATION
MAMARONECK, N. Y.

STANSTRIP*

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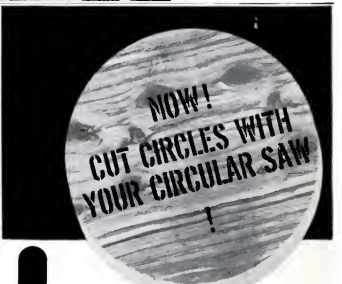
Protects garage doors . . . seals out rain, snow, drafts

StanStrip doubles garage door life by cushioning the shock of closing. At the same time, it seals out rain, snow, dirt and drafts.

StanStrip is molded from specially developed synthetic rubber. You can install it in only a few minutes. It's tough, stays soft and flexible, never sets or deforms. Follows the roughest floor contours. Protect your investment in garage doors with StanStrip. Eight-foot strip costs $2.95, 16-foot strip costs $5.90. At your hardware dealer's now. Install it this week end.

*Trade-Mark

The Standard Products Co. LEXINGTON, KENTUCKY



The amazing CIRCLE MASTER, a new patented attachment, will permit you to cut all circular shapes on any make bench saw. Simple to use, CIRCLE MASTER enables you to cut a perfect, clean and smooth circular shape. Cuts a diameter adjustable up to 30" on small saws, even bigger on large saws. You can make chairs, table tops, wheels, trays, lazy susans, stools, coasters . . . anything that calls for a circular shape. You can make cove cuts, beveled cuts, shoulder cuts, moulding cuts and many others depending upon blade used. You must be completely satisfied or your money back. Send Check or money order. We pay postage.

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DEPT. 110 • 350 BROADWAY • NEW YORK CITY

How to make strong plywood joints with Weldwood glues

BUTT JOINTS are simplest. For thinner plywood, reinforce with block of wood. Be sure wood surfaces make snug contact. Apply glue to all surfaces (two coats on end grain) and clamp. When possible, reinforce joints with nails or screws.

RABBET JOINTS look neat, give added strength to drawers, chests, cupboards. Make slot with dado cutters, or several overlapping passes with regular saw blade. Apply glue to both surfaces, clamp, and nail or screw if possible.

DADO JOINTS in ⅜" plywood increase gluing area, are made by dadoing off 9/16"-notch from end of one member. Reinforce with nails from both top and side of joint.

USE THE RIGHT GLUE

Weldwood Plastic-Resin Glue makes well-fitting joints stronger than the wood itself. Easy-to-mix powder, light tan color, resists moisture, sets in 5 to 6 hours.

Weldwood Presto-Set Glue is ideal for uses where tight clamping or good fit is difficult. Quick-drying, washable, ready-to-use white glue comes in handy squeeze bottle.

Weldwood Waterproof Resorcinol Glue should be used in joints in Exterior-Grade plywood for outdoor furniture, boats, and other work exposed to extreme dampness. Exceptionally strong, completely waterproof, sets overnight.

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Products of United States Plywood Corporation

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WELDWOOD ADHESIVES — 4 types—a glue for every purpose in a size for every need.

FLEXIBLE WOOD-TRIM—real wood veneers in handy rolls, for covering exposed edges.

Which Fireplace Is Best for You?

[Continued from page 165]

9. Smoke chamber. Above the damper, the front wall of the smoke chamber slopes backward about an inch per course of brick. After three or four plumb courses the side walls are also sloped inward at about 1½" per course. It is important that they be sloped identically and that the flue take off from the center of the chamber. The rear wall of the chamber is plumb for its entire height. This height varies from 19" for a 24" fireplace to 32" for a 42" opening.

10. Chimney and flue. The most common mistake in fireplace construction is making the flue too small. In a chimney 16′ high, the area of the flue cross section should be at least 12 percent of the area of the fireplace opening. It should be at least 10 percent if the chimney is from 17′ to 24′, eight percent if it's 26′ or higher. In multi-openings, be sure the area of all openings is totaled in calculating flue size. Chimney height is measured from hearth to cap. Any chimney under 16′ is likely to smoke.

A flue should be for the exclusive use of one fireplace. Multiple use of one flue results in weak and conflicting drafts. Sharing a flue is likely to work only if one unit uses it at a time, with the others shut off. If you build your own flue, be sure to have it checked by your local building inspector or fire department—an improperly built flue can be a fire hazard.

To prevent smoke and draft leaks, as well as fire hazards, flue tiles should be well bedded in cement at all joints, and the space between flue lining and brickwork should be packed with mortar. Where there is more than one flue in the chimney, be sure they are spaced the width of a well-cemented brick apart. Specify that change of flue direction be made by mitering tile ends, not by offsets of tile sections, and that slopes never exceed 6" to the foot.

If a chimney is capped, the area of all openings should be equal to, or greater than, the flue area. Where a chimney has multiple flues, there is some danger that smoke may come out of one and pour down the other. Antidote: Stagger the height of the tops by a few inches. To further fend off downdrafts, make a concave mortar joint where the tile emerges from the chimney top. END

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SHARK BRAND* SWEDISH CHISELS

This chisel has a sharper edge that stays sharp up to three times longer than ordinary chisels. The inherent toughness of the Swedish charcoal steel gives you a lifetime of clean, sharp bites with far fewer sharpenings.

Look for SHARK brand at your hardware store.

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No matter how old your friends' cars are, **unconditionally guarantee** them astonishing increases in compression, gas mileage and oil saving, **even let them judge for themselves!** Amazing new product **backs you up** 100%, hands you opportunity to make big money.

Build Big-Profit REPEAT Business Spare Time With NEW, IMPROVED BIGGER, BETTER MOTOR OVERHAUL NOW WITH NEW MIRACLE FORMULA X-303

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and rush it with your name, address for complete money-making plans, actual copy of sensational Lab Road Test Report, daring Guarantee . . . all FREE, no obligation. If you also want a **full-size $2.98 can of MOTOR OVERHAUL to test, enclose only $2.00. We ship postpaid. Money back if you wish.**

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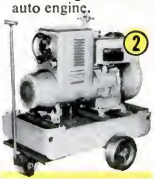
"Build Your Own"

For very low cost you can immediately get into the highly profitable welding business. With Hobart's "Build Your Own" unit, you can have a highly efficient welding machine by simply connecting a Hobart generator to a good used auto engine.



2 **"HUSKY BOY" 200 amp.**
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AC WELDER-AC POWER.
200 amp. combination that you can connect to your own power source. Lets you operate where no power lines are available. Furnishes current for welding and power for running tools, lights, etc. Build your own combination welder and power unit with a good used auto engine.

3

4 **UTILITY AC WELDER**
Superior performance, economical operation and general serviceability make this a popular model for small shops, implement shops, auto service shops, plumbing and heating contractors, farm welding, etc. Has the same features of the big industrial models.

Welding Lessons. 200 pages fully illustrated, with charts and diagrams. Self teaching. $1.00

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Select only the TAPE UNITS you want!

Pentron combines professional features and custom styling with building-block flexibility. Add components when you desire—from the simplest monaural system to the all-inclusive stereo systems.

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Featuring –

Professional head assembly with removable pole piece • Mounts VERTICALLY, horizontally or at any angle • Simple single rotary control • 4 outputs plus 2 AC convenience outlets • Speed change lever at front panel • Automatic self-energizing braking.

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All CA units have same physical dimensions and require same cutout.

CA-11: Tape Playback only. Response: 20-20,000 cps. Signal-to-Noise: 55 db

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CA-15: Stereo Dual Channel Playback. Response: 20-20,000 cps. Signal-to-Noise: 60 db

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☐ brochure on tape components

☐ literature on portable recorders

Name

Address

City and State

[Continued from page 176]

level, or parallel, with the big loop that runs around the room. At an angle off level, you begin to lessen the volume.

In a few seconds' time, you can thus find the exact tilt for the best listening pleasure no matter how high the volume is turned up on the set itself. This works in reverse too: Tip your head (or the coil) and any unwanted portions of the program are immediately banished.

To wind the coil, you proceed just as for the spaceman's version. Use the same circular form, 7″ to 8″ in diameter, the same 100 to 300 turns of wire, and the same No. 30 enameled magnet wire. The only difference is that you wind the coil as a flat band rather than a round roll. To do this, tape a 1″-wide strip of corrugated cardboard around the form first, then wrap the wire over the strip, letting it spread out from side to side. The result is a thin, narrow headband, light in weight and trim looking.

Since a single earplug is used, you'll need only one pair of flexible leads to connect it to the coil. Solder and tape these to the ends of the coil as before. Keep the cardboard strip permanently under the coil to serve as backing for the headband. For off-the-head use, leave enough slack in the leads to the earplug so that the headband can be removed and placed comfortably beside you.

At this point, you may find it profitable to turn the coils over to your wife for a final decorative touch. You may want yours plain, in which case you can simply wrap it with clear or black plastic tape. But the ladies are sure to have their own ideas about vivid wrappings of colored ribbon or bits of material.

4. *The super-deluxe earplug receiver*

If you'd like to dispense with the headband coil entirely, there's an ingenious version that will do this too. It picks up sound from the big room loop in the same way as the other receivers, but instead of a head-size coil, it uses only a tiny relay coil. The sound is then magnified by a miniature transistor amplifier powered by two small pen-light batteries.

All the parts fit into a box, no bigger than a pack of cigarettes, that slips easily

NEW G-E VR II

A dramatic new cartridge to bring you new heights in Hi-Fi performance!

New Full-range Reproduction. General Electric's VR II magnetic cartridge makes possible faithful reproduction in the frequency range from 20 through 20,000 cycles.

New 4-Gram Tracking Force. Lateral compliance of the VR II has been extended to 1.7 x 10^{-6} cm per dyne, permitting a tracking force of only 4 grams to minimize record and stylus wear.

Instant CLIP-IN-TIP Stylus. Stylus replacements can be made at home without removing cartridge from tone arm. No need to discard an entire assembly when only one tip is worn.

New Electrostatic Shielding. Prevents pick-up of electrostatic interferences and hum; also grounds stylus assembly, preventing build-up of electrostatic charges from the record surface.

New Lightweight Construction. Microscopic precision and strong, lightweight construction of General Electric's new VR II assures your continued pleasure and satisfaction.

Hear the difference! Ask for a demonstration at your dealer's.

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West Genesee Street, Auburn, New York

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GENERAL ELECTRIC

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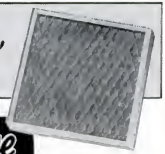
how much are 'throw-aways' costing you?



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FILTERS

Engineered to last a lifetime in your warm air heating system!

for greater economy and efficiency

Here's the filter that's sure to save you money! Eliminate discards *forever*, improve heating efficiency, cut redecorating costs. Keeps air clean for better health. Check or money order. Shipped prepaid promptly.

Easiest cleaned filter on the market — simply flush with water and replace. No messy oils or adhesives. Absolutely rustproof and fireproof.

Size	1"	2"
10" x 20"	$7.50	$8.50
15" x 20"	8.50	9.50
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20" x 25"	10.50	11.50

Prices other popular sizes on request
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ELECTRONIC ENGINEERING CO.
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Wonder-Paste is noted for its great penetrating power. Thoroughly softens toughest paint, enamel and other finishes. Easily applied with a paint brush. Stays put on uprights. Use it indoors or out —on furniture, woodwork, walls, floors. It will save you time and effort. At paint and hardware stores.

Send 25¢ for illustrated Refinishing Manual.
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REMOVER

Over 5 million cans sold—it must be good

BIG CAPACITY PROFESSIONAL RESULTS

For Building Remodeling

Here's the all-purpose, heavy-duty jointer-planer . . . preferred by professionals and experienced hobbyists. With it you can "finish out" a house, or a room, remodel, make furniture. And you can do it better, faster.

10 LB. CUTTER-HEAD ASSURES SMOOTH PERFORMANCE

Cutter-head spindle is one-piece . . . machined from solid steel, precision ground for perfect balance. 2¾" in diameter, the head alone weighs 10 lbs. Cutter blades are ground in sets and are identical in width to within .001". Table and fence are both big, and precision ground for smoothness and accuracy. Fence is rigid, triply supported, easily positioned. This is the machine you need for planing mirror-smooth surfaces, rabetting, chamfering, tapering, edging.

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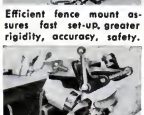
Modern, streamlined and sturdy. The perfect mount.

Efficient fence mount assures fast set-up, greater rigidity, accuracy, safety.



Cutter-head removes for sharpening blades without disturbing setting.

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Wireless TV Phones

into a shirt pocket. There's nothing else to wear or carry but a miniature earplug-type phone.

Because the volume is generally higher than with the headband receivers, this is a particularly good deal for anyone whose hearing is not as acute as it used to be. You don't have to sit in a room with the speaker blasting full tilt just because one person may require more volume than the others want.

There are only six parts in the transistor receiver and less than a dozen connections to make. Even if your wiring experience is limited to fixing lamp cords, you should have no trouble assembling the unit from the pictorial diagram on page 173.

When you shop for the earphone (available at radio-parts stores), ask for the magnetic type with at least 2,000 ohms impedance. So little power is used that the two pen-light cells will last for more than 1,000 hours.

Comparing the receivers. With the transistor amplifier unit, even the cheapest headphones give ample volume in spite of the small pickup coil used. The unamplified headband receivers will vary substantially in sound output depending on the quality of the headphones used. The best of these will match the output of the amplified version.

We tried all of the combinations listed on page 176 inside a loop 14′ by 16′. The loop consisted of two turns of No. 18 bell wire on the cellar ceiling under the listening room. The output of the TV set was matched to the loop with the matching transformer. The voice-coil leads from the set were connected to terminals 1 and 6 on the matching transformer, and the two ends of the transmitting loop were shifted among the terminals until the loudest response was obtained. These turned out to be terminals 1 and 4 for our setup. The volume control on the TV set was turned up until the sound began to distort, then backed off slightly until the distortion disappeared. We found that with any of the units listed, we could walk anywhere in the room and get satisfactory results. With the top units, we could still hear in adjacent rooms, and with the transistor unit, we could even pick up the sound on the floor above! END

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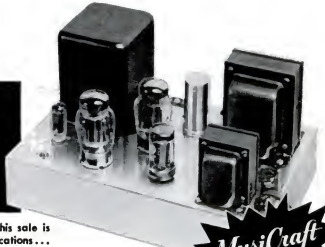
below manufacturer's cost!

60 WATT AMPLIFIER



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MusiCraft capitalized on a once-in-a-lifetime opportunity. Because this sale is limited, act fast. Look at the price ... Check and compare the specifications ... And share our enthusiasm! First run, quality components and construction.

SPECIFICATIONS

- IM Distortion....Less than 1% @ 60W.
- Harmonic Distortion....Less than 1% 20 cps. to 20,000 cps.
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- Damping Factor....choice of 15 or 30 by a switch.
- Hum and Noise Level....85DB below 60W.
- Hum Nullifier Control which compensates for aging or replaced tubes.

FEATURES

- Chrome plated chassis
- Choke filtered power supply
- Octal socket for preamplifier power connection (wired for Heathkit, Dyna-kit and other preamplifiers)
- Fuse receptacle on chassis
- Heavy duty power cord
- Biased filament supply
- Tubes: 2-6550, GZ34, 6BA8A
- Completely assembled, wired, and tested
- Dimensions—9" x 14" x 8" high. Shpg. Wt., 31 lbs.

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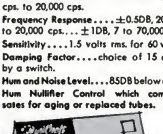

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AMAZING New Liquid that MAKES "DEAD BATTERIES" SPRING TO LIFE Instantly and MAKES NEW BATTERIES TROUBLE FREE for YEARS!

Thousands of testimonials like these

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Installed in one minute. No Tools necessary. Tested and approved by PUBLIC SERVICE TESTING LABORATORIES.

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*T. M. Reg. Easi-Bild Pattern Company

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Try New MENTHOL AERO SHAVE ...and save 20¢

Imparts a bracing tingle to even sensitive skin. 3 beard softeners *plus* gentle, soothing lanolin. Try new *Menthol* AERO SHAVE.

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We make all sizes up to 25,000 watts

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(Item 10) Easily installed in furnace pipes. Forces even heat to all rooms. Over range removes kitchen smoke and odors. Powerful, continuous duty motor. 110-120 v. AC. Mount in wall or ceiling to ventilate any area. Quiet, super-efficient fan moves huge volume of air. (400 to 600 CFM).

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HEAVY DUTY FAN. Semi-enclosed motor, suitable for spray booths, restaurant exhausts, poultry houses, etc.
10" Fan, wt. 8 lbs. (Item 10E) $11.95
12" Fan, wt. 10 lbs. (Item 10D) $12.95

HIGH SPEED BARN FAN similar to above, but larger, high speed motor moves huge volume of air.
12" Fan (Item 10f) $14.95
14" Fan (Item "0E) $17.95

FAUCET WATER HEATER

Instant hot water for just pennies—You just slip MASTER MECHANIC'S new Faucet Water Heater over any faucet—plug it in a wall outlet and you have a steaming hot water instantly for dishes, shaving, washing baby's bottle, etc. Simple and safe—operates on ordinary 110 v. house current—costs only 2½ cents per hour for hot water. Ideal for homes, shops, cabins, trailers, etc. Easily installed from faucet to full hot. *Fully guaranteed.* (Item 408) Wt. 2 lbs. Factory price $4.95

GIANT METAL SHEARS

"PEXTO" Nine inch cutting blade made of special high carbon alloy steel, perfectly aligned and ground. Easily cuts steel plate up to 12 gauge, or ⅛" thick. Overall length 40". Wt. 23 lbs. (Item 156) Regular $49.50. While they last $14.95

Send 10¢ for 100 page Catalog—FREE with order. Prices f. o. b. factory—Send check or M.O.

MASTER MECHANIC MFG. CO., Dept. 30-R, Burlington, Wis.

Buying Snow-and-Mud Tires
[*Continued from page 85*]

four times. It's a good long-term investment, especially if you don't plan on an early car trade-in. But if you'd rather save some money, there's no reason not to buy the lower-priced rayon.

Both tubed and tubeless snow tires are available in the 15- and 16-inch sizes. All the new 14-inchers are tubeless. You can use tubed tires on front and tubeless on the rear or vice versa.

One way to save money on snow tires is to buy retreads (also called recaps). Your chief gauge of quality in these is the integrity of the dealer. A sound carcass when properly retreaded is practically as good as a new tire [see "How to Buy Good Retreads," Sept. PS].

A dodge worth considering when you buy a new car (one a B. F. Goodrich development man told me he practices) is to take a snow tire instead of the usual spare and buy an extra wheel and a second snow tire for it. By carrying one as a spare you're covered against flats, while switching for the winter is simply a matter of changing wheels. Despite the cost of the additional wheel you're still ahead.

NEXT MONTH: Is your horn silent when you need it, irritating to your ear, or apt to embarrass you with unsolicited blaring? It's in your car to speak for YOU. In case it doesn't—read November PS.

Your own worn casings—rayon or nylon, snow tires or regular, tubed or tubeless—can be recapped with some of the snow treads of leading manufacturers—B. F. Goodrich, Seiberling or Goodyear, for example. Check carcasses for breaks, separation of plies, nail holes and cuts—or have a conscientious dealer do so for you. The modern full recap carries new rubber right down over the shoulders, and tread depth should be the same as in new snow tires. There's a big saving: Recaps cost only one-third to one-half as much as new tires. One tire-company engineer told me he has never yet bought any snow tires but recaps for his own car.

Shop for bargains. Savings over advertised list prices are also possible on brand-new snowies. Watch the sales, but be sure you get exactly what you think you are buying. END

5 POWER TOOLS IN ONE

NEW Dremel Deluxe MOTO-SHOP

Complete Power Workshop
In One Compact, Portable Unit

The amazing new Dremel Moto-Shop is the most versatile multi-purpose tool ever invented. Has 1,001 home and shop uses. Basically, it's a 19" Jig Saw with a unique power take-off to which you simply connect other attachments. It then converts to a disc sander, bench grinder, buffing wheel, and a flexible-shaft machine . . . all powered by a BALL-BEARING ROTARY MOTOR.

And this professional-quality, portable power shop can be set up practically anywhere — basement workshop, kitchen counter or card table. Weighs only 12 lbs. As a Jig Saw, it will cut 1¾" wood, 18 gauge copper, 1/16" steel — all with same blade. Foolproof blade guard makes it absolutely safe — even for children. Handles everything from birdhouses to full-size furniture.

The flexible shaft is a complete machine shop in itself. Use it for sharpening, grinding, polishing, drilling, carving. Collet capacity 1/64" to ⅛". Other attachments have hundreds of home and shop uses.

Moto-Shop is the perfect "ALL FAMILY" workshop — safe for even mom and the children. Helps build a close father-son relationship.

See Your Power Tool Dealer for a Demonstration Today!
Model 57 Moto-Shop. Includes Jig Saw with disc sander attachment only. Other attachments can be added later - - - **$33.95**
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Price of attachments only, if purchased separately - - - **$19.95**

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Subsidiary UNITED-CARR FASTENER Corporation

"Zip" Fuels Pack More W-H-O-O-S-H

[Continued from page 89]

to the pound, and then lithium, with 18,000. Ores of both were plentiful. Boron, because of its higher heating value, was the more attractive one. From there on, the scientists' task was to find ways to combine boron and hydrogen—and possibly other "alloying" elements—in a safe high-energy fuel that could be manufactured at reasonable cost. That trick has now been successfully turned.

It's a pleasant irony that boron, now so vitally linked to power and speed, comes from borax, which calls to mind the plodding 20-mule teams of the past and the humdrum role of scrubbing the nation's kitchens. California's blistering Mojave desert contains a large percentage of the world's borax, found generally at places where salty lakes or inland seas have evaporated.

Continuing to explore other zip-fuel possibilities, researchers currently are mixing many a weird brew in laboratories throughout the nation.

Metallic powders—such as magnesium, aluminum and lithium—are being blended with combustible liquids, to make some of these still-experimental fuels. Others contain such unfamiliar chemicals as aluminum trimethyl, whose preparation requires exclusion of any trace of air or moisture; on contact with air, it spontaneously bursts into flames.

The eeriest avenue of research involves "free radicals"—the highly unstable fragments, with names like "methyl" or "hydroxyl," of torn-apart molecules. Because of the enormous energy that some free radicals release when they recombine, they fascinate the fuel researchers. A new technique makes it possible, after generating high-temperature streams of free radicals, to trap them on surfaces chilled to extreme cold with liquid nitrogen or helium. Thus frozen, the normally short-lived particles have been kept for hours. This raises the vision of storing free radicals on a large scale, carrying them aloft as frozen fuel, and thawing them at will for their tremendous energy release. While that may still be far in the future, free-radical research already is actively under way for the armed forces, with the National Bureau of Standards playing a key role under a tri-service contract.—*Wesley S. Griswold.*

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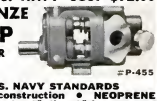

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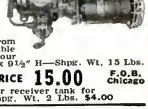

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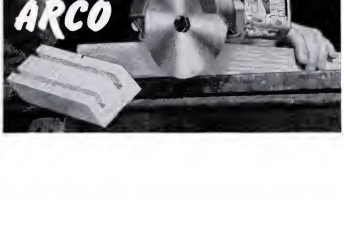

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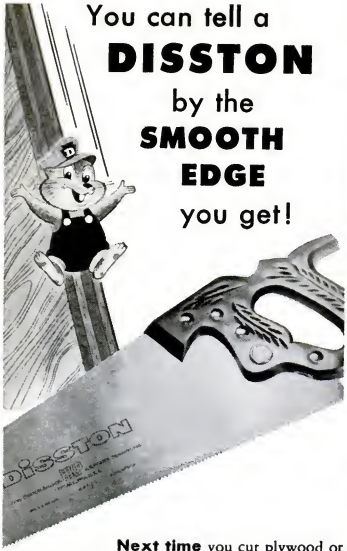

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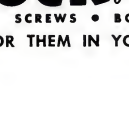

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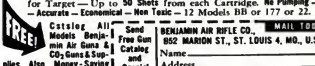

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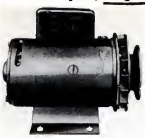

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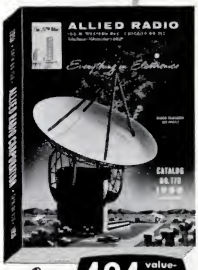

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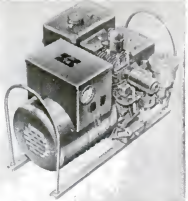

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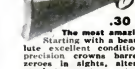

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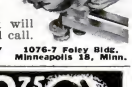

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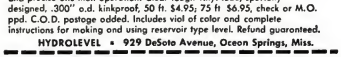

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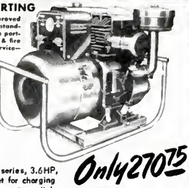

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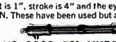

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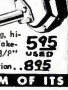

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Tunnel Built Like a Shotgun

[*Continued from page 98*]

When he had worked out the angle of repose for Baltimore harbor, Singstad decided to try to save more millions by building his tunnels like the twin barrels of a shotgun and lowering the two connected barrels into the same trench at the same time.

Eyebrows shot up all over the place. Even if they could build a double-barreled shotgun 70 feet wide, 35 feet high, a mile and a half long, how could they get it into place? A tunnel is, after all, a road of steel that cannot flow or give like asphalt. Nor can it be patched. A single pot-hole in the base, a single bump could mean irremediable disaster. Therefore the base for this kind of road must be leveled off absolutely true to grade. It must have firm support under each foot of its length and width.

"Mr. Singstad showed us how to do the base," said Ed Jones, Resident Engineer on the job, "and we're doing it. When I tell people how, they don't believe it. For what it amounts to is dumping sand off the roofs of two rows of 10-story buildings that stand on opposite sides of an excavation wider than a boulevard. We measure out enough sand to cover the bottom with a layer two feet thick, then dump it from the roof. It falls in a watery mass through a hundred feet of water to the bottom of the excavation. The men above can no more see it than if they were blindfolded, yet they have a way to level it out true to grade to a tolerance of 1.2 inches!"

While the base is being prepared, 300-foot lengths of the tunnel, prefabricated on land, are launched like ships, towed to their sites, jockeyed into position, and sunk in the trench. The two sections that take the tunnel up the grade at each end resemble the elbows of prodigious stovepipes. These unprecedented behemoths are as unlikely a sight at sea as a flying arch would be, taking off from the runway at La Guardia airport. Even those who had studied the blueprints were surprised at how easily they could be launched, how readily they rode the waves from shipyards as much as 120 miles away.

When the sections are in place divers go down. In a blackness so blinding they can scarcely tell whether their eyes are open at all, they feel their way through the task of lining up the slots and bolt holes; then they bolt the sections together. When this is done the sections are cemented rigidly into place. Finally sand and gravel fill are dumped in, filling in the trench above the tunnel.

Ole Singstad is now 75 years old, but even after a long day he looks and acts in his spry, wiry 50's. On a stifling summer afternoon I went out with him to watch him straighten out some of the problems of his newest creation.

Slippery muck-covered beams naked of handholds stretched over blackly yawning caverns. We went over them as if they were sidewalks. Once, when I was slipping, he hauled me erect with a pull like a derrick. We jumped from the decks of small boats to barges and back again. We sprinted up and down the stairs of the nine-story ventilation buildings where the elevators had not yet been installed. Finally, though I am 30 years his junior, I had to call a halt. "Take it easy, Ole," I said.

He was all solicitude. "I'm sorry. I've been doing this for so many years I forget there are people who might not be used to it."

Ole Singstad has won many honors for his work: he is an honorary member of the American Society of Civil Engineers, a Decorated Officer of the Order of the Crown of Belgium, Knight First Class of the Royal Norwegian Order of St. Olaf. But the thing that counts most with him is that, despite the best efforts of man and nature to destroy them, all the tunnels he has built are still working.

Ships have sunk over Singstad's tunnels, trucks have exploded in them, floods and hurricanes have battered them—all without serious damage. During World War II Singstad's tunnel under the Scheldt in Antwerp was dynamited twice—once in 1940 by the retreating Belgians, again in 1944 by the retreating Germans. Both times the tunnel shrugged off the blasts; all the dynamite did was damage some fans in the ventilation buildings on shore. When you ask Singstad about this amazing record, he smiles. "It's all a matter of mathematics," he says. "And remember, an engineer can't afford to make a mistake." END

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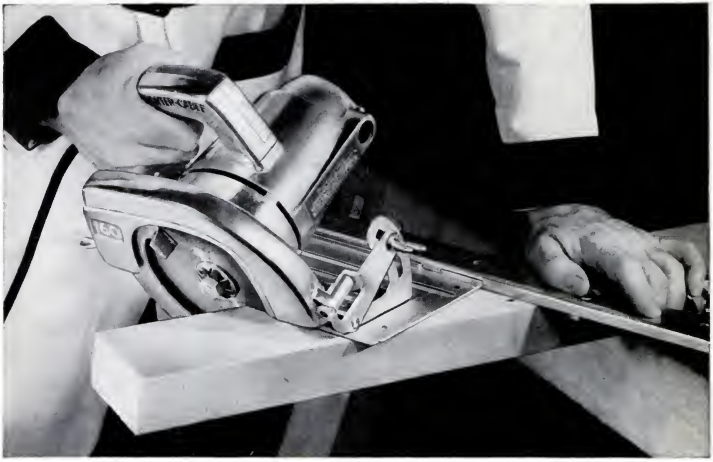

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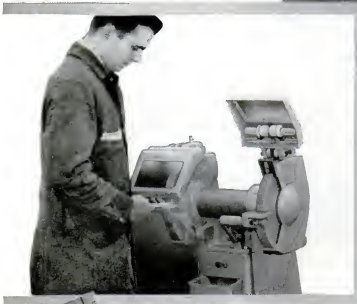

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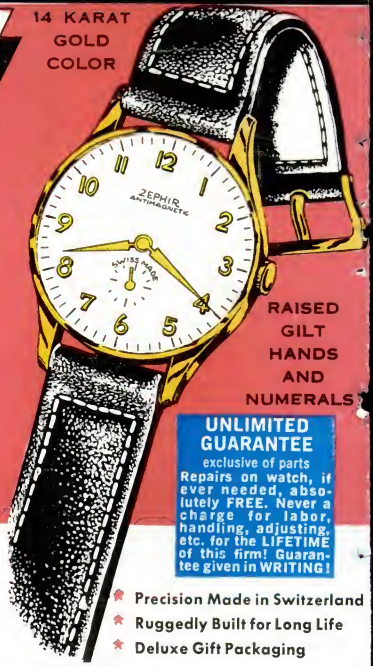

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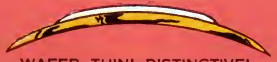

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☐ CHECK here if you wish DeLuxe Model with 14-karat gold color metal expansion band. Only $2 more. 9.98 plus 99¢ Federal tax. TOTAL: $10.97

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